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The Journal of the American Welding Society

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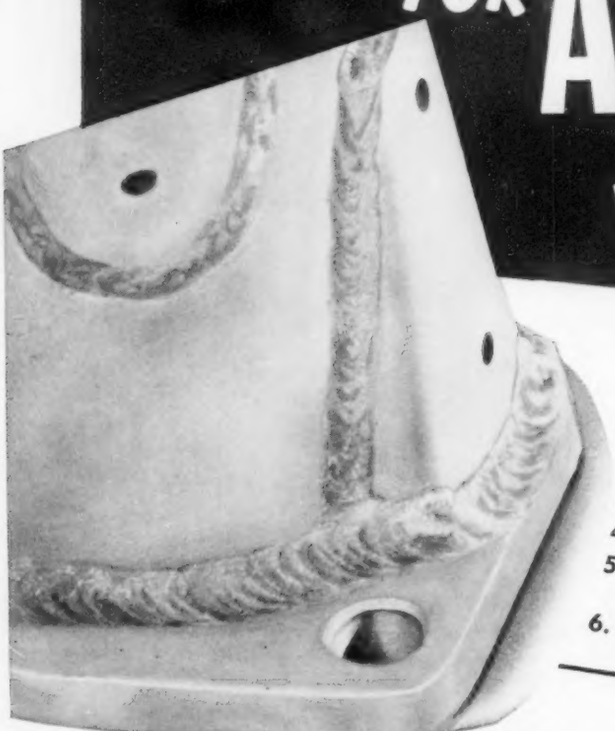

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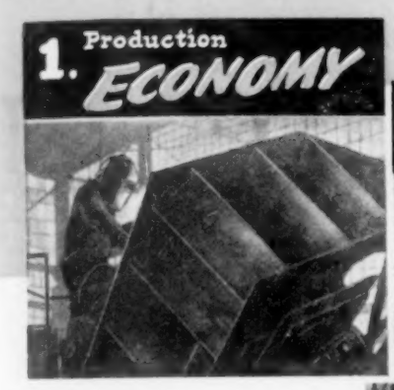

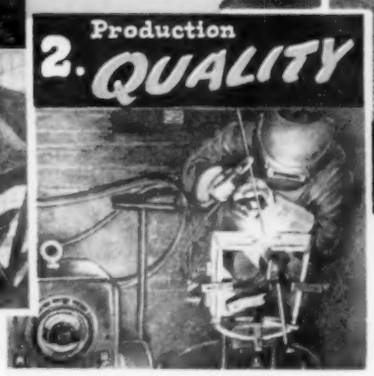

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Published for the Advancement of the Science and Art of Welding

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JULY, 1945

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CONTENTS

TECHNICAL PAPERS, ITEMS AND REPORTS

Welding as an Aid in the Fabrication of Ordnance Matériel, by Colonel Scott B. Ritchie 629

Current Welding Literature 634

Design and Fabrication of an All Welded Pressure Scalder, by W. J. Conley 635

Safety Control for Arc Welders Eliminates Shock, by Herbert Mahumed ..... 63[illegible]

Welding Structures of Hastelloy Alloys, by J. A. Gallaher ..... 64[illegible]

The Restriction of E6012 Electrodes, by Omer Blodgett ..... 65[illegible]

Templet Tips, by Rudolph Chelborg ..... 65[illegible]

SOCIETY AND RELATED ACTIVITIES

Twenty-Sixth Annual Meeting 660

By-Law Revisions 660

Board of Directors Meeting 660

Report on Readers' Interest in The Welding Journal 662

INDEX TO ADVERTISERS 662

A Letter to the Editor 668

V. E. Day—And the Part Welders Played 668

Welding Research Will Improve Postwar Production 670

Non-Magnetic Uses of Manganese Steel 674

New Manual on Projection Welding. 674

Cutting Tool Practice 674

Ampcoloy Bronzes 676

X-Ray Diffraction Apparatus 676

Flash Welding 676

The Future of Welding ..... 67[illegible]

Cass to Foote Mineral ..... 67[illegible]

Hess Promoted ..... 67[illegible]

Prefabrication of Postwar Homes ..... 67[illegible]

Chemical Formulary ..... 67[illegible]

Hasse Promoted ..... 68[illegible]

Welding Research Council Appoints W. Spraragen as Director ..... 68[illegible]

Welding Electrodes ..... 68[illegible]

Fact Sheet on U. S. Coast Guard Icebreaker *Mackinaw* ..... 68[illegible]

Blacksmith Re-Soles Horseshoes with Electric Arc Method ..... 69[illegible]

New Products ..... 69[illegible]

Section Activities ..... 69[illegible]

List of New Members ..... 7[illegible]

Members Reclassified ..... 7[illegible]

Employment Service Bulletin ..... 7[illegible]

WELDING RESEARCH SUPPLEMENT

Investigation of the Final Rinsing Operation in the Chemical Surface Preparation of Alclad 24S-T for Spot Welding, by R. A. Wyant, D. J. Ashcraft and T. B. Cameron .. 361-s

Arc Welding of Rail Steel, by C. B. Haynes, W. H. Graft and R. G. Spencer 369-s

The Impact Strength of Some Metallic Arc Weld Metal Deposits at Elevated Temperature, by John F. Eckel and R. J. Raudebaugh ..... 3[illegible]

Fatigue Strength of Fillet, Plug and Slot Welds in Ordinary Bridge Steel—Report No. 4 of Committee on Fatigue Testing (Structural) ... 3[illegible]

The Journal of
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Welding as an Aid in the Fabrication of Ordnance Matériel*

By Colonel Scott B. Ritchie†

IT IS indeed a pleasure to participate in the celebration of the 25th Anniversary of the AMERICAN WELDING SOCIETY, by discussing welding as an aid in the fabrication of Ordnance matériel. This SOCIETY has made great progress in these 25 years in the advancement of welding. It may well be proud of its distinguished record. The Ordnance Department is grateful for the assistance rendered by the SOCIETY. We have leaned heavily upon you for assistance and advice. Many of the problems we have presented have not been easy, but these—as well as others—have been handled by the SOCIETY in an efficient and expeditious manner.

Several years ago, I had the pleasure of addressing the Cleveland Chapter of this SOCIETY on "Welding in Ordnance Matériel." The Ordnance Department was then in the midst of a huge program for the mobilization of science and industry in the development and manufacture of weapons to meet the needs of our armed forces and our allies. This program has been so stupendous and has covered so many types of Ordnance matériel that it is difficult to comprehend its magnitude. It involves more than 2000 major items—such as tanks, self-propelled artillery, armored cars, bombs, aircraft machine guns, aircraft cannon, ammunition, propellants and high explosives. A measure may be conveyed by stating that the grand total of the Ordnance program for the manufacture of weapons, ammunition and equipment to date is about 65 billion dollars.

Fig. 2—Light Tank, M22

Used for airborne operations. Can be carried by present cargo-type aircraft.

The success of that program is largely due to the partnership formed by the Ordnance Department early in the emergency with science and industry. The program, initiated in September 1940, when the Ordnance Department received its first emergency appropriation of two billion dollars, was based on weapons which had been continuously under design from 1918 to 1939. The Department had been handicapped in those years in the design and development of weapons, due to lack of funds. Yet, much had been done, and when the program was initiated in 1940, designs of the basic Ordnance weapons, ammunition and equipment were available immediately to manufacturers.

The Ordnance Department, however, looked to the future, and realized at that time the need for partnership with science and industry in order that it might cope successfully with the changes war would demand. This partnership was formed and has been successful beyond all expectations. I am happy to say that the AMERICAN WELDING SOCIETY has played its part well as a member of that team.

In all this great program of developing and manufacturing arms and equipment, welding has played a

* Presented at the Twenty-Fifth Annual Meeting, A.W.S., Cleveland, Ohio, Oct. 16 to 19, 1944.

† Office, Chief of Ordnance, Washington, D. C.

Fig. 1—155-Mm. Gun Motor Carriage, M12

These helped to break the back of the Germans on the western front.

Fig. 3—90-Mm. Gun Motor Carriage, M36

Nicknamed the "Slugger," it is used primarily against tanks. Note streamlined welded construction.

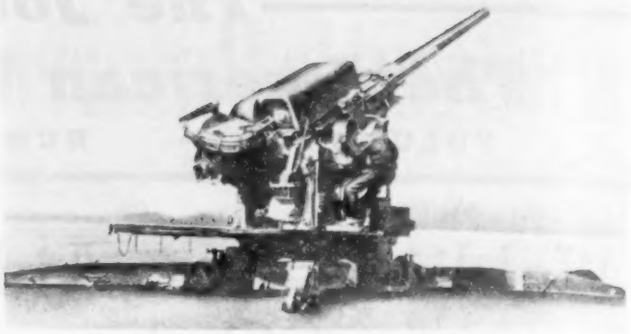

Fig. 5—120-Mm. A.A. Gun, M1, on Mount, M1

The so-called stratosphere weapon of the Army. This gun will fire high explosive ammunition to greater altitudes than any other known antiaircraft gun in the world. Note welded construction used throughout.

major role. It is one of the fundamental processes, without which many of the advantages our troops now hold against the enemy, both in quality and quantity, would have been impossible. Many have come to accept welding as though "it just happened," that it reached its present stage of refinement through a normal, but perhaps mysterious evolution. This is not the case, as you know, for much exhaustive research has been conducted and rapid commercial development has been accomplished within a comparatively short period.

Without this, other methods or processes would have been used instead of welding, the results of which cannot be determined at this time. Suppose, for example, the inadequacy of welding had forced designers to accept other methods or processes as a standard for matériel design. Our tanks would still be riveted and therefore more vulnerable—our artillery would be heavier and either be less maneuverable, or have less firepower—our vehicles would carry more dead weight—our planes would be slower—and on and on throughout the long range of the weapons of war.

Welding has played a major role in this war because designers have been able to take advantage of a process which offers more liberal design possibilities with less production limitation. You men of industry, who have worked unceasingly to reduce the cost of welding, and you men of science and engineering, who have worked so tirelessly to develop new types of electrodes and equipment and to improve processes, to bring the quality of welding to its present high standards—each of you, and all of you, should feel proud, and rightly so, of the important and significant contributions you have made to your country at war.

The Ordnance Department has always been aware of the transcending importance of research and development for national defense. It has been carrying on welding research and development for many years. The primary purpose of welding research is to determine suitable design and performance criteria which will serve as an adequate basis for future applications. This would seem to cover a very broad field, but in reality, most of this work will fall in one of the following categories:

1. New procedure and material development.
2. New testing and inspection methods.
3. Metallurgical examinations.

New procedures, involving both technique and design are always under investigation so that the quality of welding may be controlled in accordance with the service requirements of the job. For example, recent studies have indicated that with a given armor composition and a selected welding procedure, the ballistic integrity of a welded joint may be predicted within reasonably accurate limits.

Material development is carried on to produce new supplies, equipment or processes. This work is done at government laboratories, with outside research agencies,

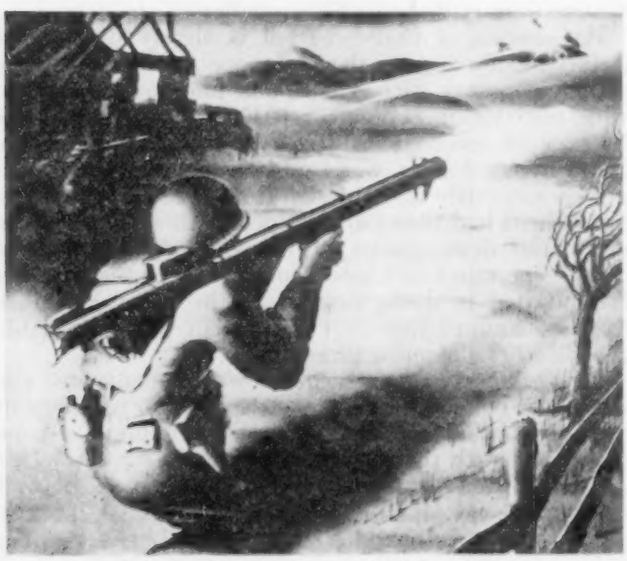

Fig. 4—Rocket Launcher, M1 (Bazooka)

Welded tubing plays an important role in construction of this very important weapon.

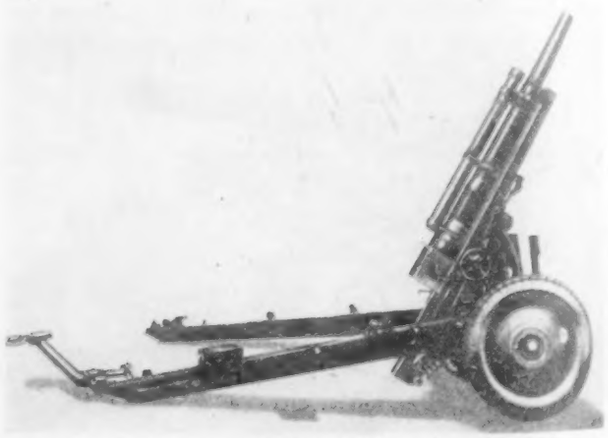

Fig. 6—Howitzer, 105-Mm., M2 on Carriage, M2

Welded construction is used throughout. This weapon is so-called backbone for the Army since it has been used more than any other artillery piece in this war.

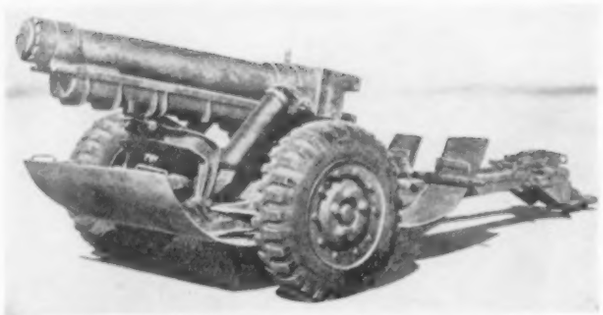

Fig. 7—Howitzer 105-Mm. M3, on Carriage M3A1 Modified with Skid Pan for Operation in Mud

This is a compact design which gives great mobility and is suitable for airborne operations. The Howitzer cradle, as well as other parts of the carriage, are of welded steel construction.

with industrial facilities, or in cooperation with all three. One of the major developments of this war has been a new type ferritic electrode for the welding of material of high hardenability. The studies involved in this development have indicated that revolutionary thinking is required when considering welding of this type. Further investigative study is necessary, however, before final conclusions are reached; but, it is believed that the research men and engineers concerned with this development are on the threshhold of a major discovery which will constitute a forward step in welding steels of high hardenability.

It is absolutely essential that materials entering into Ordnance weapons and ammunition have the maximum uniformity and reliability. The failure of material in service would not necessarily be a matter of dollars and cents, but rather it would be measured in time and casualty lists and lost battles. Quality of materials is assured by proper and adequate specifications through which control of welding is maintained.

The applications of welding in Ordnance can be divided into two classes, namely, constructional and ballistic. This is based on the concept of usage of the material, rather than type or composition. The physical characteristics, heat treatment or welding details incident to a given application, however, may be quite different for the two classes, even though the same composition is used. However, certain basic standards apply to all welding applications. These include, among others, such standards as nomenclature, symbols, joint design, qualification of operators and qualification of welding procedures. Development of these standards into suitable specifications is part of the over-all plan to control Ordnance welding and these, then, may be referred to as "basic specifications." In regard to control of welding of specific matériel, such as artillery, ammunition, armored vehicles and small arms, "item specifications" are available. These include special instructions peculiar to that particular type of weldment.

In order to more effectively coordinate our welding activities, there was established an Ordnance Welding Committee, the purpose of which was to correlate all welding activities throughout the Ordnance Department and establish standards for all Ordnance welding applications. This Committee is made up of representatives of various arsenals, services and divisions within Ordnance, and meetings are called as needed to dispose of the problems which are presented, and to formulate and recommend policies with respect to Ordnance welding.

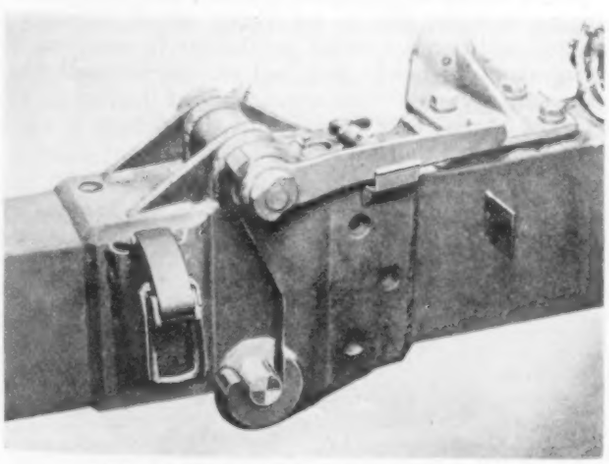

Fig. 8—Detail of 90-Mm. Mount A.A. M2

A closeup of an outrigger connection showing the extensive use of welding.

Fig. 9—Howitzer, 240-Mm. M1, on Carriage M1

Trails and Carriage are of welded steel construction. This monster fires a 360-lb. high-explosive projectile.

Fig. 10—Howitzer Carriage M1

This mobile carriage of welded construction is used interchangeably with the 240-mm. Howitzer and 8-in. Gun, thus giving flexibility and simplifying field supply and maintenance.

To further correlate the efforts of the Ordnance Welding Committee with industry, and as a result of assistance which was most graciously offered by the AMERICAN WELDING SOCIETY, there was formed an Advisory Group to the Ordnance Welding Committee, which is known as the A.W.S.-Army Ordnance Advisory Committee. This Committee is made up of representatives of industry and Ordnance, and it is their responsibility to deal with specific problems as requested by the Department through the Ordnance Welding Committee. The advantage of such a Committee is apparent, since it tends toward mutual cooperation and a better understanding of the problems which exist in both Ordnance and industry.

Since quality requirements must be enforced through inspection, it was considered desirable to prepare a *Welding Inspection Handbook* for metal arc welding. This manual would serve as a convenient source of informal technical information, relative to the inspection and testing of weldments. The *Welding Inspection Handbook* was the first undertaking of the A.W.S.-Army Ordnance Advisory Committee. It has been

completed and reviewed by Ordnance, and will be available in the near future to Ordnance and other welding inspectors within the Army Service Forces. These include other departments such as Transportation Corps, Signal Corps, Chemical Warfare Service, Corps of Engineers and Quartermaster Corps. It is understood that the AMERICAN WELDING SOCIETY expects to issue the same data as a *Handbook on Inspection of Manual Arc Welding*. This, of course, is the kind of cooperation and coordination that was hoped for when the A.W.S.-Army Ordnance Advisory Committee was organized.

Now, I should like to mention a few of the specific advantages of welding. In matériel design, there are a variety of approaches, each unique in itself, and all challenging the combined engineering ingenuity of Ordnance and industry. Welding plays a very important part in matériel development since it permits design and engineering freedom. In fact, it is inconceivable how modern weapons of war would have been possible without the use of welding.

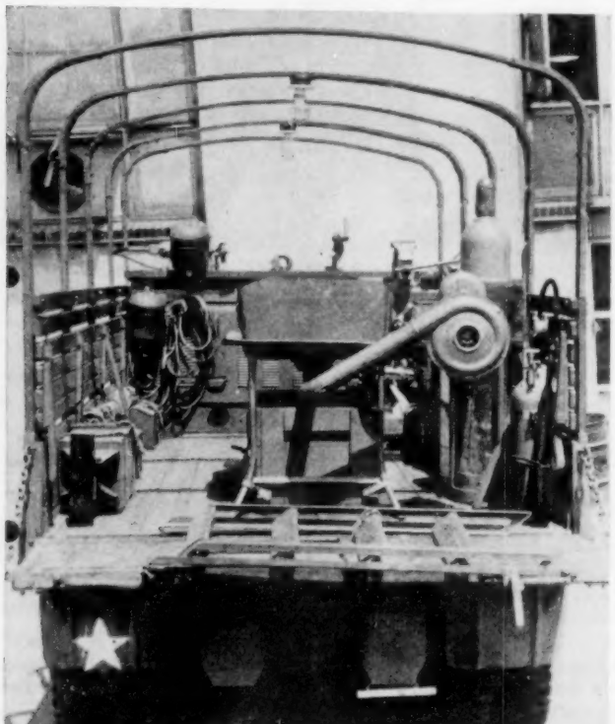

Fig. 11—Ordnance Maintenance Welding Truck, Set L

This is one of the jobs used for effecting emergency repairs in a forward area. Note the oxygen and acetylene tanks, forge, gas engine driven welder, etc.

By designing to welded steel construction, a saving in weight of from 15 to 40% is frequently realized. Pleasantly enough, these savings are often accompanied by a cost reduction of from 10 to 30%, as compared to the old design. In many cases, however, a cost saving, particularly in war times, is of secondary importance since it is always desirable to improve service performance. It is interesting to note that under these conditions, designing to welded steel construction usually results in improved service performance, without an increase in either weight or cost.

Simplicity seems to be one of the fundamental advantages of the welding process, since it offers an easy, quick and economical method for meeting functional requirements. During the war emergency, time is of such importance that it is reflected daily in the success or failure of combat operations. Emergency jobs requiring a quick redesign—to strengthen a member—to change a part for improved performance—or to fabricate and deliver a particularly vital piece of equipment where needed and on time—can be of signal importance. The flexibility which the process offers can be of tremendous advantage in this regard. Believe me when I say that welding has permitted us to come through on many occasions when the going was rough.

Fig. 12—Box, Ammunition, Cal. .50, M2

It is interesting to note that welding made it possible to make up a container which can be hermetically sealed. Arrows indicate welding.

The changing requirements in the field, necessitating either a complete redesign of a part, or a cut back in production of one item which may be accompanied by an increase in production of another item, previously presented many problems to industry concerning inventory. These problems have been solved to a great extent through the use of welding, because in general, standard shapes, bar stock or plates are used wherever possible, and new design developments may not render existing stocks of material obsolete.

Up to this point we have discussed the advantages of welding as applied to new design or a redesign. Salvage and repair of matériel in the field, however, represents Ordnance welding applications of considerable magnitude. Rarely is it necessary to completely scrap a vehicle, a carriage or any component part thereof. It is truly amazing how quickly a tank which has been knocked out, can be put back into action—how vehicles or carriages can be repaired and returned to service—or how existing matériel can be reinforced where necessary to provide additional combat protection to overcome the performance of newly designed enemy weapons which may suddenly make their appearance at the front. This work, of course, is of tremendous significance in all the theaters of operations.

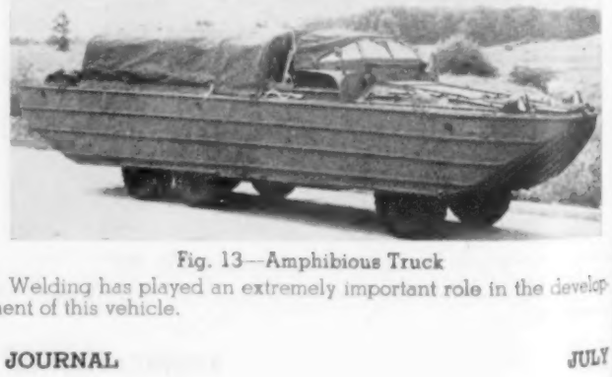

Fig. 13—Amphibious Truck

Welding has played an extremely important role in the development of this vehicle.

Weld surfacing is a process which covers an extensive and important field in Ordnance welding. The scope and possibilities of weld surfacing are almost unlimited, and include such applications as building up worn shafts, reclaiming grouser plates, hard surfacing lunettes and many others. The savings effected through the use of weld surfacing are definitely spectacular if one considers the cost, handling and shipping space involved were it necessary to replace such parts entirely with new components.

One of the many assets of the welding process is the ability to use the type metal required commensurate with the work at hand. A case in point is an elevating arc on a carriage where it is possible to weld a low alloy web plate to a higher alloy flange. This satisfactorily meets the service requirements of the job and, at the same time, conserves essential strategic alloys.

It would seem almost unnecessary to mention the fact that welding lends itself readily to high rates of production. Subassemblies can be easily jigged and set up for quantity production. Assembly lines can be developed with established procedures to obtain maximum production efficiency. When a nation is faced with total war, production is paramount—and welding expedites production. Briefly, then, it may be stated that the principal advantages of welding in the fabrication of Ordnance matériel are:

1. Flexibility of design.
2. Time savings.
3. High rates of production.
4. Cost or weight savings.
5. Better service performance.
6. Field salvage and repair.

In this war, emphasis has been placed on amphibious operations. Landing of great armies and securing beachheads has generally been the initial phase of every major undertaking. An amphibious vehicle is not a new idea. Inventors have been working on this problem for a great many years to develop a practical vehicle that would operate on land as well as in water. In fact, Oliver Evans built a 15-ton Amphibolos Orukter in 1805 for the Philadelphia Board of Health to dredge the Delaware River dock area.

This ponderous wooden, steam-driven vehicle traveled up Market St. from the Evans Machine Shop to Center Square under its own power. After a few days of public demonstrations, the Orukter moved on the banks of the Schuylkill River, and was launched at low tide. As the tide rose, the dredge floated free of its wheels, and majestically chugged down the Schuylkill and up the Delaware, independent of wind or current. While the Orukter was not considered particularly practical, it was just as much a revelation in those days as was our amphibious vehicle, the "Duck," when it first made its dramatic appearance during one of the early amphibious operations.

Without the use of welding, the building of the hull of the "Duck" would probably have been impractical. Replacement by rivets of 1300 ft. of arc welding, and approximately 8000 spot welds would have constituted a fabrication problem of great magnitude, and the problem of keeping it water tight over the extreme service conditions encountered in use would have been virtually impossible. Because of the simplicity of the all-welded construction, the first experimental job was completed in less than a month after instructions were issued for its design, and production was under way a month later. In spite of the large number now in the field, less than a dozen failures have occurred which can be attributed to welding defects.

By incorporating basic advantages of welding into Ordnance matériel as a design feature, and further making use of the high standards and qualities developed by the cooperation with industry, the pay-off has been tremendous.

The design and production of Ordnance matériel does not stop short of the goal of technical dependability—it operates at that level. Whereas, in typical industrial production of commercial products, malfunctions of the order of $\frac{1}{2}$ of 1% may not be considered excessive, such a performance would be sufficient cause to discard many of our weapons for use in warfare. The standard of performance of Ordnance equipment is indicated by the acceptance specification requirement for caliber .50 aircraft machine gun that there be not more than two malfunctions during the firing of a 5000-round endurance test. The 0.04 of 1% includes the combination of gun and ammunition. Hence, the allowable defects in the ammunition must be much less than 0.04 of 1%.

With this example of performance normally required for Ordnance matériel, it may prove of interest to review a few practical welding applications. The developmen of high-strength, welded tubing of close dimensional tolerances to meet pressure applications ranging from 2000 to 12,000 psi., with guaranteed quality has been an outstanding industry achievement. Designs requiring extremely thin walls in this class of tubing, have been produced in large quantities. In this category are the 2.36-in. rocket (better known as the "Bazooka"), the 4.5-in. rocket and the M9A1 Anti-Tank Rifle Grenade. During 1943, over 3,500,000 ft. of welded tubing were produced for the Bazooka and the Rifle Grenade. In

Fig. 14—4000-Lb. Demolition Bomb

A so-called "Baby Block Buster." The circumferential and longitudinal seams, lugs and fins are welded.

Fig. 15—Gun, Submachine, Cal. .45, M3
Arrows indicate points of welding.

Fig. 16—Gun 155-Mm. M1A1 on Carriage M1
It is easy to see why operations in this war are often referred to as mobile. Welding of course, has helped to make this possible. This gun played a very important part in breaking the back of the Germans in France.

the field of bomb production, welded tubing has been the principal source of casings. The huge quantities of bombs required could never have been made had it been necessary to rely on the forgings and castings originally specified. In 1943, one company alone used 160,000 tons of plate to make 1,100,000 500- and 1000-lb. bombs. In the larger sizes, welding was the only practical method of fabrication.

The distribution and supply of artillery ammunition required light-weight containers, capable of withstanding rough handling. In addition, it was necessary that the sealed container be capable of withstanding severe atmospheric and ground conditions. The quantities of tubing required amounted to 25 million feet to be produced in less than 8 mo. This load was undertaken in its entirety by the Welded Tube Industry. This utilized gas and resistance welding facilties.

Similar standards of quality have been incorporated into designs and production of mortar shells and fin assemblies using spot and projection welding. In addition, the shell body has been fabricated by stamping plate and flash welding the formed plates. In 1943, over 18 million 81- and 60-mm. fin assemblies were produced by making use of this technique. A notable example of welding is in the millions of rounds of H.E. shell, each of which has a 0.030-in. gage steel plate welded on the base as a precaution against gas leakage through the base and malfunction in the gun tube. Such malfunctions must not occur as they are disastrous to both gun and gun crew.

The outstanding application of welding in the fabrication of gun trails and gun carriages in all classes of guns, represents one of the earliest welding achievements of the Ordnance Department. With importance being increasingly placed on light-weight construction, further advances have been made with the use of high-tensile plate. Now, we are thinking of fabricating welded structures by use of structural alloys, heat treated to yield strengths of 100 to 150,000 psi. The quality of the standards of the welding industry has kept pace with these requirements, and we anticipate this will continue. During 6 mo. of 1943, over 14,000 tons of low-alloy, high-tensile plate went into fabrication of gun mounts.

Use of welding as applied to small arms assemblies has proved of outstanding assistance in production of these weapons. As an example, the barrel jacket of the caliber .50 M2 Aircraft Machine Gun was formerly made from tubing. This tubing was perforated for cooling effect by punching one row at a time, making the process slow and expensive. By using flat strip steel, perforating, forming into a tube and welding, the production was materially increased, and a great saving in man-hours and dollars was accomplished. Another example is the caliber .45 M3 Submachine Gun. This gun is composed almost entirely of steel stampings and welding is used in assembling the components, particularly the receiver. By processing the M3 in this manner, it has been possible to reduce its cost by more than one-half the lowest cost ever obtained on the conventional type of fabrication. Welding is also used in assembling the tripod mounts of the caliber .30 and caliber .50 machine guns for ground and aircraft purposes.

The improvement in combat vehicle contours and quantity production of these items was primarily due to the technical development in the art of welding. Approximately 60,000 tons of armor plate were welded during June 1943. The amphibious vehicles, such as the "Duck" and "Alligator," owe much of their success to the quality and quantity of work obtained by welding.

It has been pointed out that welding has played a major role in the development of weapons of war. In fact, it can even be said that welding, itself, is a weapon of war—because of its importance to the design, fabrication and maintenance of Ordnance matériel.

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(*Continued on page 639*)

Design and Fabrication of an All Welded Pressure Scalder

By W. J. Conley†

ARC-WELDED construction is ideal for products involving the use of fluids. Sheet metal, plates and structural shapes can be joined economically to make containers which are permanently leakproof. Also, sheet metal and plate stock can be formed and welded directly without reinforcing, although it may be necessary to combine the lighter gages with structural shapes such as angles in order to obtain the desired rigidity.

By planning carefully, the sub-assemblies of the machine size of the weldments can be designed to suit the facilities and capacity of the individual fabricating shop. This should be planned so as to minimize the amount of welding and thereby get the lowest fabrication cost.

The amount of welding is minimized by forming parts by means of brakes, rolls and cold drawing or stamping. This is important not only in designing the separate weldments, but also in the choice of joints for the final assembly. Wherever possible, the parts should be assembled so as to eliminate as much handling as possible.

The scalder shown in Fig. 1, built by the Allan Iron and Welding Works, Inc., Rochester, N. Y., illustrates the versatile and practical use of arc welding for economical fabrication. The unit shown has a capacity of five (5) tons of vegetables per hour and weighs approximately five tons. Vegetables are processed in water held at a temperature which creates a low steam pressure. This means that the unit must be pressure tight. The scalder was conceived and designed by an engineer of the company who supervised the construction in the company's shop.

The first unit built had a capacity of approximately two tons per hour.

By conventional methods, several months would have been required to complete this first unit and an expenditure of thousands of dollars would have been required for special shop equipment.

It was built by arc welding in several weeks . . . and built at a good profit. Equipment used—all available—included an oxygen cutting machine, shears, brakes, rolls and arc welding equipment.

Planning of the design by sub-assemblies was approached from the point of view of the function to be performed. Referring to Fig. 1, the grouping is obvious: the base support for the body (D), the body (C), the feed conveyor (A), the discharge conveyor assembly (B), the paddle wheel (Fig. 8), platform (E), brackets (F), sprockets and bearings.

Figure 2 shows the discharge elevator for the five-ton cooker. Fig. 3 (A, B, C) and Fig. 4 show its component parts.

The vertical walls are made of $^{3}/_{16}$-in. plate. The discharge hood is 10 gage stock for units of less than five tons capacity, while larger ones use $^{1}/_{4}$-in. plate. Figure 3 shows a layout for 10 gage material. The angles are welded to the sheet in the flat position with the whole unit clamped to a platen to prevent warpage.

Figure 5 illustrates the position of the welds necessary for pressure tightness. Angles A′ on each side are welded with a continuous bead, $^{1}/_{4}$-in. diameter E-6012 electrode, 250 amp., 18 in. per min. arc speed. Angles B′ are welded intermittently in each case, using 2-in. fillet welds on 6-in. centers (same type and size electrode). The end pieces are then assembled with these in position

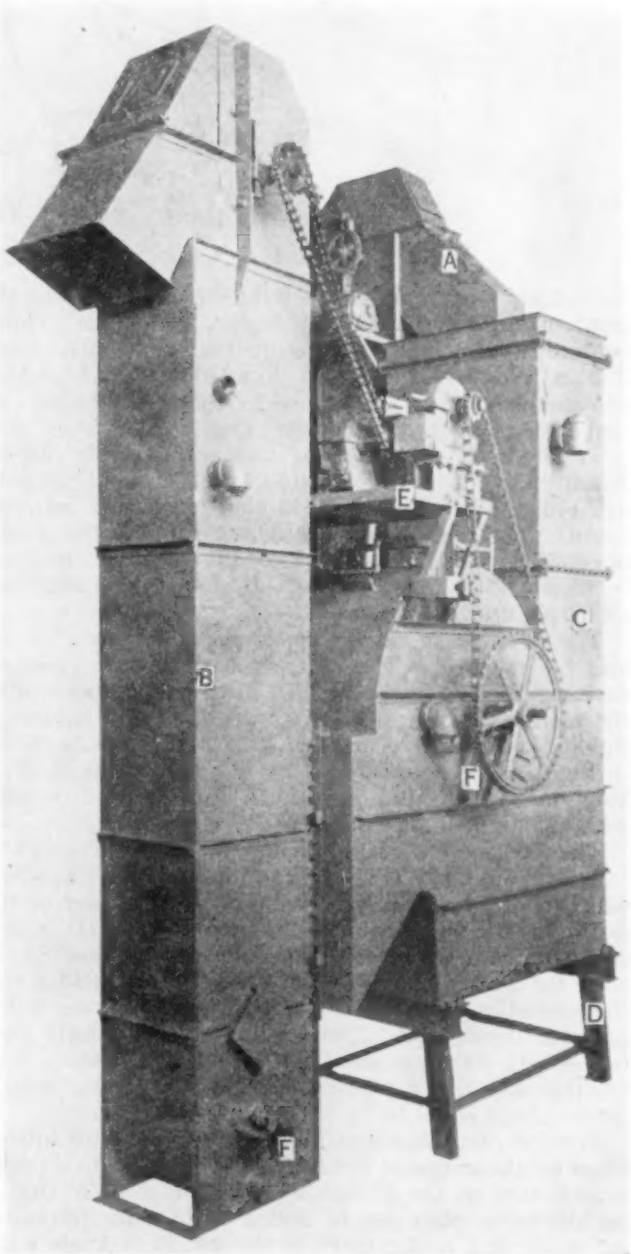

Fig. 1

† Consulting Engineer, Lincoln Electric Co.

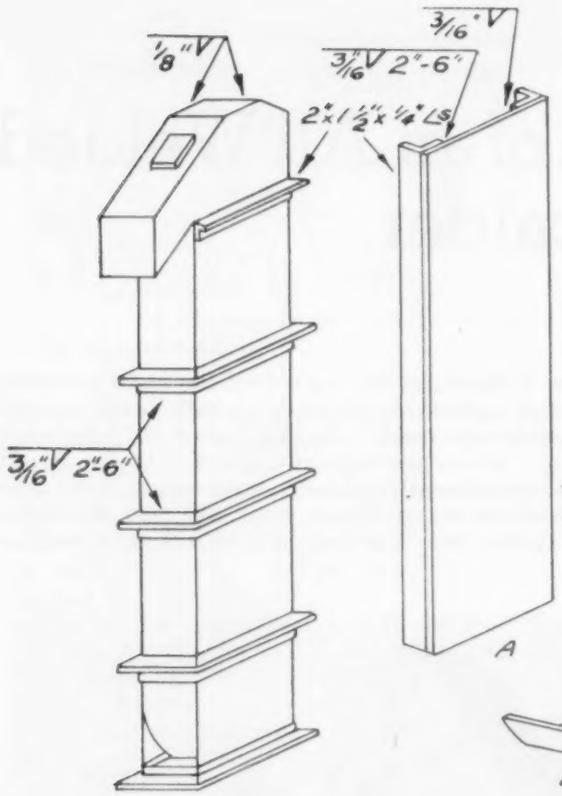

Fig. 2

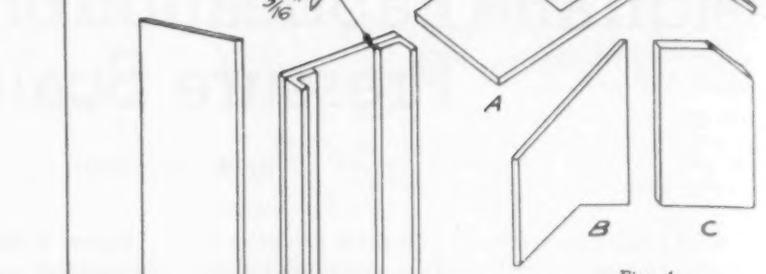

Fig. 4

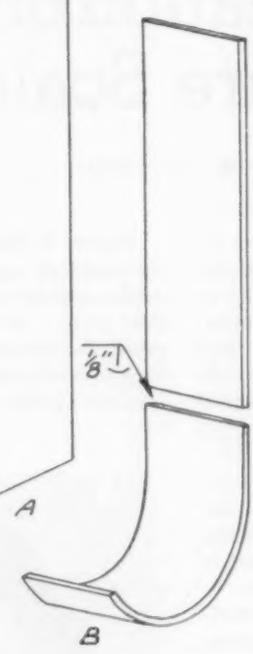

Fig. 3

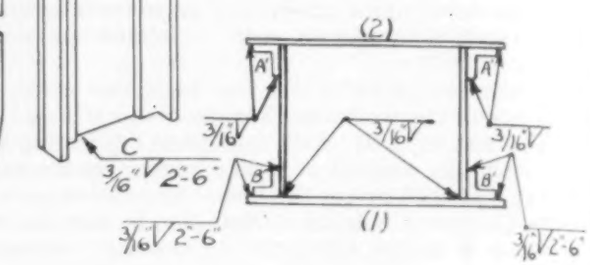

Fig. 5

for flat welding. Sheet (1) is welded continuously on the inside to the side plates with $^3/_{16}$-in. fillet welds. Outer edges of Sheet (1) are then welded intermittently, using 2 in. x $^3/_{16}$ in. beads spaced 6 in. Sheet (2) is welded continuously to the angles, using $^1/_4$-in. E-6012 electrode and same procedure as for Sheet (1).

The hood for the discharge conveyor assembly (Fig. 1, B, top) is welded in flat position, corner weld fit-up, with a $^3/_{16}$-in. E-6010 electrode, 180 amp., 25 in. per min. arc speed. The joint fit-up consists of lapping the sheets one-half their thickness. The hood is welded to the stock by means of a $^1/_4$-in. E-6010 electrode with 200 amp. and 18 in. per min. arc speed.

The vertical stack for the larger units uses $^3/_{16}$ in. and $^1/_4$ in. plate. The plate is clamped into position, tack welded and corner welded in the flat position with the stiffener angles added after welding. The necessary rigidity is obtained with 2 x $1^1/_2$ x $^1/_4$-in. angles as shown in Fig. 2. These are joined by $^3/_{16}$-in. fillet welds 2 in. long and spaced 6 in. A $^1/_4$-in. E-6012 electrode is used with 275 amp. and arc speed of 12 in. per min.

The feed conveyor is fabricated in a similar manner.

The main body (Fig. 6) contains the paddle wheel which controls the time of scalding and transfer of the load from the feed to the discharge conveyor. It is constructed of $^3/_{16}$-in. plate for the smaller units and $^1/_4$-in. plate for the larger ones. The parts are tack welded and the assembly positioned for flat welding. Corner welds are used throughout. These require $^1/_4$-in. E-6012 electrodes with 300 amp. and 18 in. per min. arc speed. The fit-up is such that a nearly full open joint is used with a throat about equal to $^3/_4$ of the plate thickness.

The end plate shown in Fig. 7 is prepared with square edges by shearing and burning. The other plate is made as indicated by the dotted line. This is done so that a circular cover plate can be bolted on to make provision for repair and replacement of the paddle. Angle stiffeners are used and welded as indicated.

The paddle wheel (Fig. 8) illustrates an application where the simplicity and flexibility of welded construction are used to full advantage. It consists of two $^1/_4$-in. circular plates of 5 ft. diameter containing ten paddles for the unit. The function of the paddle is to scoop up, carry the load around through a given time cycle and drop the material into the discharge bucket conveyor. The paddles are constructed so that they can pass freely through the hot water. They consist of 47—$^1/_4$ in. x $^1/_4$ in. x 1 foot 8 in. bars welded to two pieces of flat stock using fillet welds along the sides of the bars. Parts are set up in a fixture, facilitating assembly and making it possible to have all the fillet welds in the horizontal position. Welded with $^1/_4$-in. E-6012 electrodes.

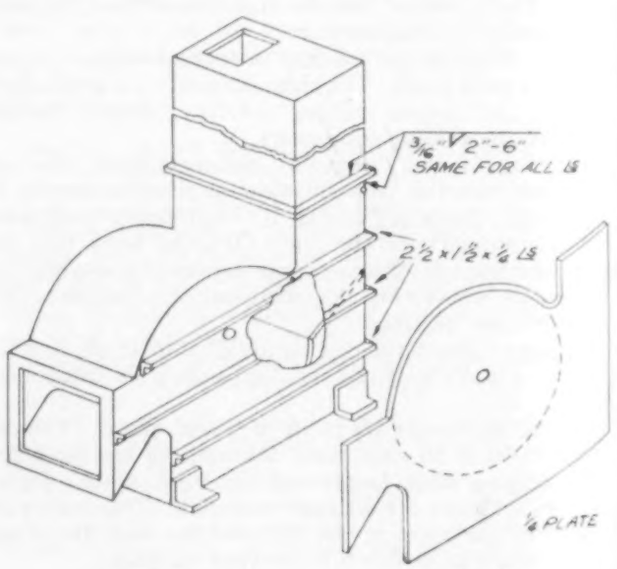

Fig. 6

Fig. 7

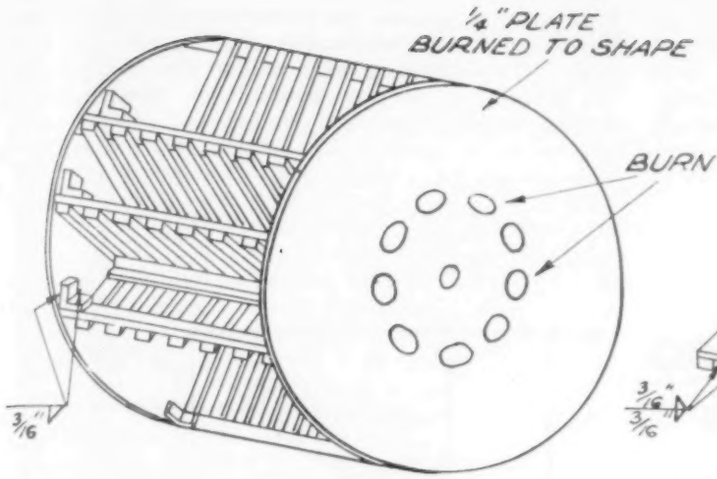

Fig. 8

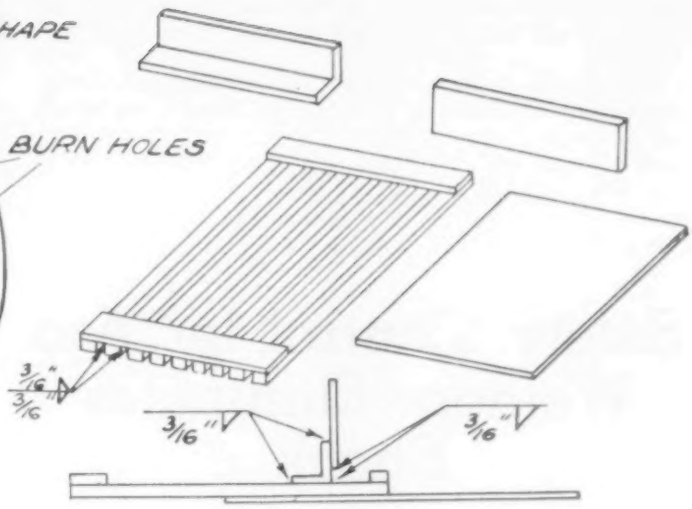

Fig. 9

Figure 9 shows the paddle details and a cross-section with the size of welds for assembly.

The only other heavy part is the base support for the main body, shown in Fig. 10. This is made of structural shapes: one wide-flanged I-beam, standard I and angle sections. The fit-up is planned so that square butt and fillet welds are used as indicated in Fig. 10.

Figures 11, 12 and 13 show smaller components for which welding made possible speedy and economical construction. Figure 12 is of special interest, for this pressure gland is made entirely of standard stock material. The design was made to accommodate all shaft openings.

The buckets for the conveyors were welded with a minimum length of bead, since the 10 gage stock was sheared and bent so that only $^{3}/_{16}$-in. fillet welds, with a total length of 8 in., were necessary.

Figure 11 shows a typical bracket. This and the angle iron platforms for motors, drives and pumps complete the machine.

The three main units—feed conveyor, body and discharge conveyor—are assembled by bolting the angle frames together with packing used between them to give pressure tightness. This method of assembly is necessary to permit accessibility of parts for maintenance.

It will be noted that all welds are smaller than usually specified for a structure of this size. This is true because of greater penetration due to higher amperage and arc speeds. This gives a stronger weld than is possible with a bead having larger dimensions and made in the conventional manner. The procedures necessary to obtain

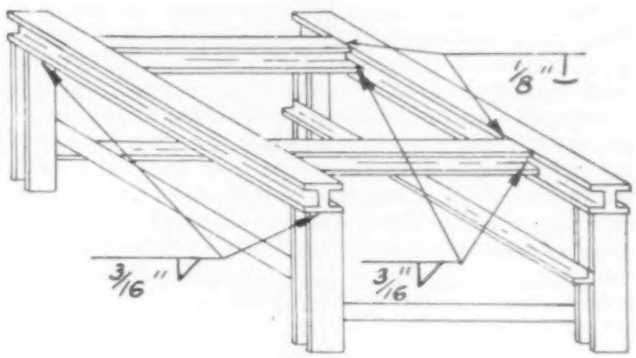

Fig. 10

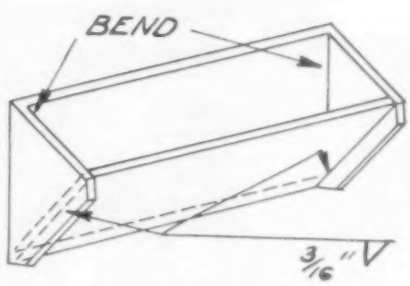

Fig. 11

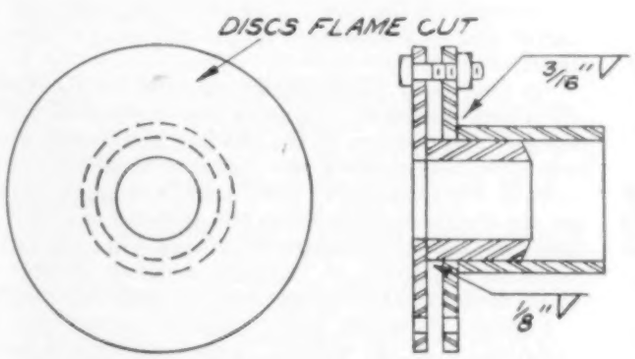

Fig. 12

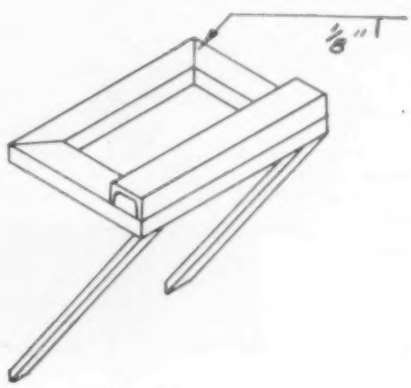

Fig. 13

these results for all types of joints as compared to the conventional welds are given in our "Fleet-Welding" Bulletin.

The design of the conveyor units was dictated by the equipment available in the shop. Larger holes would have allowed making the corners by forming the steel, thus eliminating considerable welding and the corner angle. This would greatly reduce the cost and take full advantage of the possibilities offered through welding construction.

Safety Control for Arc Welders Eliminates Shock

By Herbert Mahumed*

SAFETY has always been a prime consideration of Pullman-Standard Car Manufacturing Company, and with the introduction of a.-c. transformer welders in its shops, the safety angle was thoroughly investigated. In the fabrication of railroad cars, some of the arc welding is performed while the operator is standing or leaning against various parts of the car, to which the ground cable is attached. With perspiration-soaked clothes and gloves there is always the possibility of shock, even with insulated electrode holders. The open-circuit voltage of the various makes of transformer welders used varies from 85 to 110 v.

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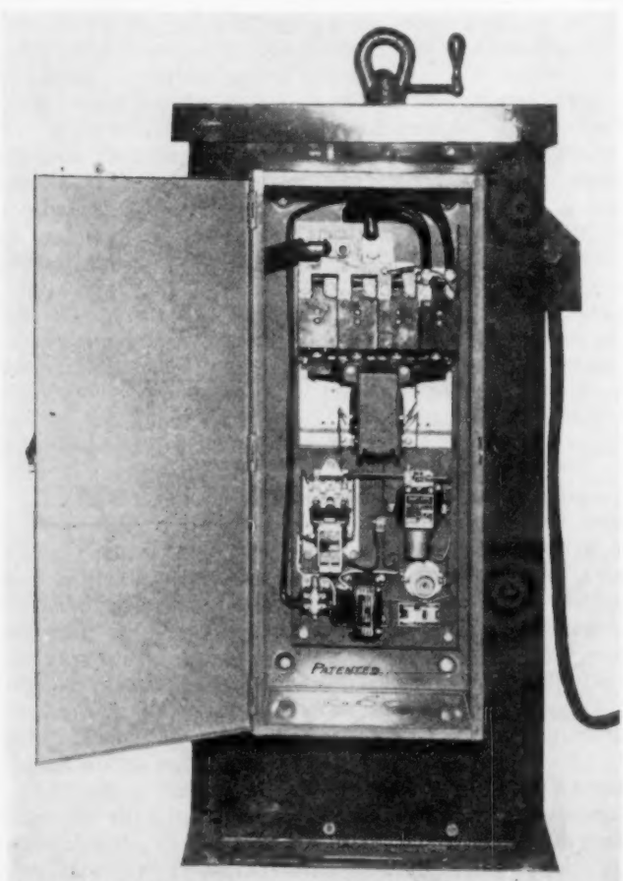

Fig. 1—View of Panel

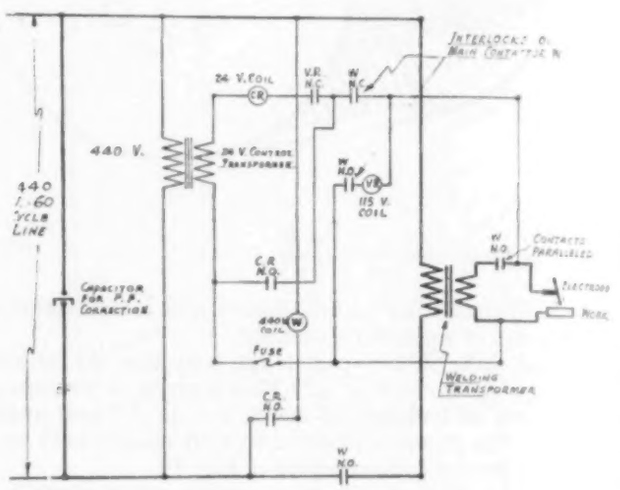

Fig. 2—Schematic Circuit Arc Welder Safety Panel

The engineers made a study of the technical data available on voltage which would be dangerous to experience under all circumstances. Under severe conditions involving clothes wet with perspiration, contact with the metal being welded and physical exhaustion, the maximum voltage permissible for a. c. is 24 v. For d. c. the maximum voltage permissible is 110 v.

Yet most welding equipment uses voltage from between 85 and 110 v. of a. c.

Various types of then-existing "safety panels" were tested in the Michigan City plant but all of them, however, had some drawbacks such as erratic operation, lag in striking the arc, excessive maintenance, etc. It was, therefore, decided to develop a new control suitable for use under the rather severe operating conditions found in a freight carbuilding plant.

At first, only the welding (secondary) circuit was broken, but the later design, finally adopted, breaks both the primary and the secondary circuits, leaving the capacitor (if the welder is so equipped for power-factor correction) on the line. This results in improved power factor due to elimination of the idle load of the transformers.

In the safety panel finally adopted by the Pullman-Standard electrical engineers the control isolates the open-circuit voltage of the welding equipment from the electrode holder when the operator breaks the arc. A control voltage of 24 v. (the "safe" voltage) is impressed on the electrode cable when the operator is not welding, and functions to complete the circuit when the electrode contacts the work, so that the welding transformer is again connected to the electrode and welding proceeds.

Figure 1 shows the safety panel in its steel cabinet as installed on an arc welder. This safety panel may also be installed on motor-generator a.-c. welders (secondary approximately 180 cycles) on which the open-circuit

voltage is about 90 v., which also results in severe shocks under favorable conditions.

Figure 2, a line diagram, shows how the 24-v. control energy is obtained from the transformer shown.

Relay *CR* has a 24-v. coil.

Relay *VR* has a coil so selected that the rise in secondary voltage of the welding transformer, when welding is interrupted, will open the contacts. At the Pullman-Standard shops a 115-v. coil is used. As first designed, there was no time delay on the relay *VR*, and the circuit would go back to "safety" as soon as the welder broke the arc. While this worked out very well, more than 100 of these panels being in use, it was decided on the last lot of panels made, to make a short-time delay ($^1/_2$ to 1 sec.) to aid in starting the arc and to avoid fluttering of the relays in operation.

Contactor *W* is a heavy-duty type, having a 440-v. coil. It has as many poles as may be required. At Pullman-Standard shops a 4-pole, 100-amp. contactor is used. Three poles are paralleled by means of a bus strap to handle the welding current (up to 500 amp.) the other pole being used to break the primary circuit of the welding transformer. In the case of the motor-generator sets, a three-pole contactor is used, as the motor must be left running, to avoid delay in welding.

None of the relays has current flowing through its coils when the operator is not welding, and failure of any of the relay coils or contacts means that the operator cannot weld.

The sequence of the operation is as follows:

(*a*) To strike an arc the operator establishes contact between the electrode and the work, which completes the 24-v. control circuit and picks up relay *CR*.

(*b*) Relay *CR*, when energized, closes the 440-v. coil circuit of contactor *W*. This action then impresses full welding voltage on the welding electrode and enables the operator to get his welding arc.

(*c*) Relay *CR* is held in by one of its normally open contacts.

(*d*) Interlock contact *NC* on contactor *W* isolates the control relay *CR* from the welding voltage.

(*e*) Interlock contact *NO* on contactor *W* closes and completes the energizing circuit of relay *VR*. The welding voltage (25 to 40 v.) is not high enough to pick up relay *VR*, so long as the arc is maintained.

(*f*) When the operator breaks the arc, the sudden rise in secondary voltage to a value of from 80 to 105 v. (depending upon the make of the welder) picks up relay *VR*.

(*g*) Relay *VR*, picking up, breaks the normally closed contacts *VR* and so opens the holding circuit of relay *CR*.

(*h*) Relay *CR* in dropping out, opens the contactor *W* circuit and de-energizes the contactor. This isolates the welding transformer secondary from the electrode holder and restores the 24-v. control voltage to the electrode. Relays *CR* and *VR* and contactor *W* remain de-energized.

(*i*) Contactor *W* in opening breaks the primary circuit of the welding transformer. In this manner, the automatic control circuit serves a dual purpose: (1) increases safety of a.-c. arc welding; (2) eliminates the power consumption of the welding transformer when the operator is not welding.

Another important advantage of the automatic disconnect feature is the improvement of the system power factor, by removing "idle" transformers from the line. When welding transformers (not loaded) are left on the power line, their power factor is very low, because the load is highly inductive. This low power factor load tends to drag down the system power factor.

Where power factor corrective devices are installed, shown as an optional device in the circuit diagram, the foregoing statement would not strictly apply. However, most of the a.-c. welding transformers now in service do not have the shunt capacitors to improve the power factor. As shown in the circuit, the capacitor would be left on the 440-v. line at all times. Thus, the power system would obtain the corrective benefit of the capacitor at all times, regardless of whether the operator is welding or not. Welders have accepted this safety device enthusiastically and report no difficulty in striking the arc.

The same type safety panels are now in use in all of the Pullman-Standard plants on all welding machines from the smallest to the largest sizes, without any change being required. Length of electrode leads does not affect the functioning, nor does current setting of the machines, thus the panels are ideal for shop conditions where the machines are frequently moved and the character of work changes continually.

The panels actually aid in improving production, as the welders change electrodes without being constantly on the alert for shocks, and relief from actual nervous tension is quite noticeable.

For any type of welding where the worker may receive the open-circuit voltage of the welding machine, this new patented safety panel contributes greatly to the safety and ease of mind of the employees.

The development is the result of collaboration of A. C. Lohse, general power engineer of all Pullman-Standard plants, R. S. Kenrick, electrical engineer, formerly with Pullman-Standard, and Wilbur K. Schroeder, works engineer of the Michigan City plant.

Current Welding Literature

(*Continued from page 634*)

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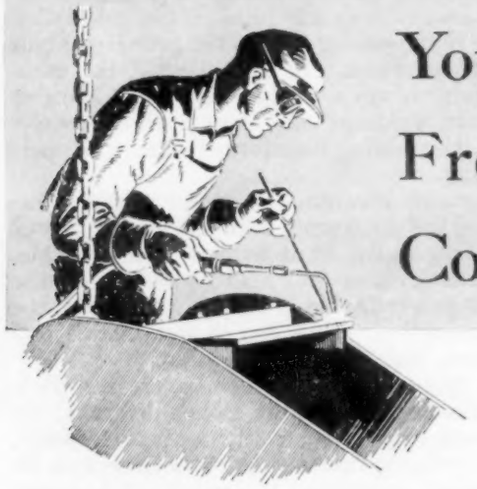

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Welding Structures of Hastelloy Alloys*

By J. A. Gallahert

"HASTELLOY" nickel-base alloys are high-strength, corrosion-resistant metals used for the construction of chemical plant equipment that is subject to severe corrosion. They are being used generally for equipment handling such active chemicals as hydrochloric acid, sulphuric acid and oxidizing agents, as well as for equipment used in many organic chemical processes that employ corrosive catalysts, like aluminum chloride.

As indicated in Table 1, Hastelloy alloys A and B contain molybdenum and iron in a nickel base; alloy A has approximately 20% molybdenum and 20% iron, and alloy B contains approximately 30% molybdenum and only 5% iron. Hastelloy alloy C, the most complex of the four, is mostly nickel but also contains approximately 15% molybdenum, 15% chromium, 5% tungsten and 5% iron. Hastelloy alloy D is a nickel-base alloy containing approximately 10% silicon.

Table I—Principal Welding Features of Hastelloy Alloys

Hastelloy Alloy	Composition, %	Weldable Forms	Welding Process	Principal Use	Average Rockwell Hardness
A	Ni Mo-20 Fe-20	Cast	O-A	HCl	B-92
		Wrought or Rolled	(1) M-A (2) O-A		B-96
B	Ni Mo-30 Fe-5	Cast	O-A	Hot HCl	B-95
		Wrought or Rolled	(1) M-A (2) O-A		B-98
C	Ni Mo-15 Cr-15 W-5 Fe-5	Cast	(1) O-A (2) M-A	Cl_2 [O]	B-93
		Rolled	(1) M-A		B-91
D	Ni Si-10 Cu-1 Al-1	Cast	O-A	H_2SO_4	C-52

Resistant to Many Chemicals

The uses of these alloys are not confined to special chemicals. To illustrate, Hastelloy alloys A and B—developed primarily for corrosion resistance to hydrochloric acid—are giving excellent service in handling other reducing chemicals and acid chlorides. They also have resistance to sulphuric acid, phosphoric acid, acetic acid and many corrosive organic chemicals. Alloy A is for relatively low-temperature applications; it is used to handle hydrochloric acid only to a maximum of 160° F. Hastelloy alloy B, however, can be used in handling all concentrations of hydrochloric acid at temperatures up to and including the boiling point.

Alloy C has been used for a number of years for handling sulphuric acid, hydrochloric acid, mixtures of nitric and sulphuric acid, and especially for the many strong oxidizing agents such as ferric chloride, cupric chloride, wet chlorine gas and organic chemicals. Although this alloy is not so resistant to strong hydrochloric acid as the A and B alloys, it is more resistant to weak aerated solutions.

Hastelloy alloy D is used chiefly for handling hot sulphuric acid, but it has good resistance to phosphoric, cold hydrochloric and many other acids.

Variety of Forms Available

All four of these Hastelloy alloys are supplied in a variety of forms. Alloys A and B are supplied in the form of hot-rolled sheet and plate; forgings; welded tubing; welding rod (alloy B only); wire; and castings such as cast pipe, fittings, and valve and pump parts. Because these two alloys can be hot rolled and forged, they are fabricated into many kinds of equipment.

Hastelloy alloy C is available in hot-rolled sheet and plate but cannot be supplied in forgings or hot-rolled bars. Hastelloy alloy D is supplied in the form of castings only.

Fabricated by Welding

All of these alloys can be welded readily, and welding shops experienced in welding materials, such as Monel, stainless steel, nickel and other metals, can usually adapt their practices to welding Hastelloy alloys.

For many years, practically all welding of these alloys was done by the oxyacetylene process. With the proper procedure, this process gives adequate corrosion resistance in the weld. The chief precautions that have to be taken in oxyacetylene welding all four of these alloys are avoiding carbon pickup and overheating. Carbon pickup can be minimized by using a neutral flame, taking care to avoid an excess of acetylene. Carbon pickup is particularly detrimental to Hastelloy C, because this alloy contains chromium and thus picks up carbon much more readily, increasing the corrosion rate. Because of the physical characteristics of Hastelloy alloy D, the oxyacetylene process is the only suitable method for welding in ordinary production.

Use of Atomic-Hydrogen Arc

Atomic-hydrogen welding has been employed with these alloys very successfully and in at least one way is superior to oxyacetylene welding; there is no possibility of carbon pickup in the weld. The principal difficulty with the atomic-hydrogen process for these alloys, however, is controlling the heat, to prevent overheating the weld metal and the areas adjacent to the weld. If the

* Presented at the January 19th Meeting, Chicago Section, A.W.S.
† Haynes Stellite Co., Chicago, Ill.

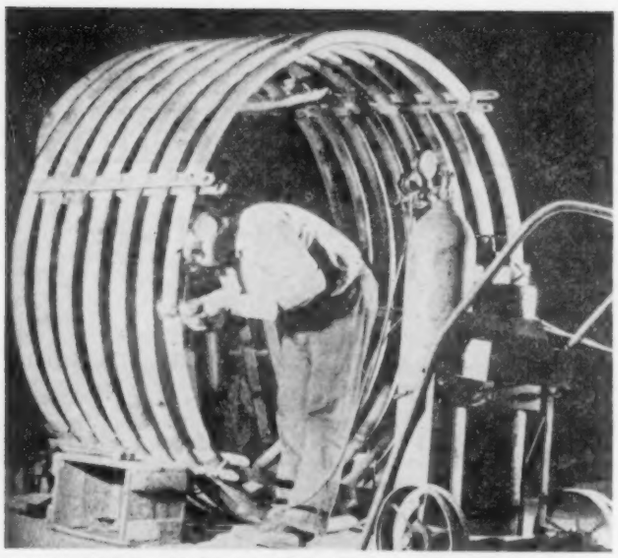


Fig. 1—This Coil Is Being Fabricated from Short Cast Sections of Hastelloy C Pipe by Oxyacetylene Welding with a Neutral Flame

metal is overheated, a certain amount of corrosion resistance is lost, particularly in the sheet adjacent to the weld. With proper control, however, an operator can produce satisfactory results by working rapidly along the line of the weld.

Metallic-Arc Process Best for Alloys A, B and C

The most satisfactory all-around welding process for sheet and plate of Hastelloy alloys A, B and C is the metallic-arc process. Electrodes of the same alloys are used except with Hastelloy A, for which alloy B electrodes are used. Problems of electrode coatings and welding techniques have been solved to such an extent with alloys B and C that coated rods that will produce strong, corrosion-resistant welds are now available in both these alloys.

It might be mentioned in passing that all four of the Hastelloy alloys have also been welded recently on an experimental basis by both the "Heliarc" and "Unionmelt" welding processes. The work on these types of welding, however, is still in the development stage, and although preliminary results look very promising, particularly with the Heliarc method, it is too early to state definitely that this type of welding will be entirely satisfactory, and further work will have to be done before recommendations can be made as to where this welding process is best adapted.

Welding with such gases as propane and hydrogen has also been done on a limited scale, with but little advantage, if any, over the oxyacetylene or atomic-hydrogen processes. With the straight oxy-hydrogen process, some difficulty has been encountered in getting sufficient heat to make a satisfactory joint.

Fig. 2—Steel Is Readily Joined to Hastelloy Alloy C, as in These Steel-Jacketed Alloy Pipe Bends, by Oxyacetylene Welding

Oxyacetylene Welding A, B and C Castings

The principal precaution required in oxyacetylene welding these alloys is to prevent overheating and to avoid any pickup of carbon.

Satisfactory oxyacetylene welds have been regularly obtained on cast pipe and castings of all four alloys. A Hastelloy alloy C coil, as illustrated in Fig. 1, is thus fabricated of short cast sections. A neutral flame should, of course, be maintained. When large castings are to be welded, it is necessary to preheat to a dull red heat so as to avoid possible cracking difficulties. On small castings of Hastelloy alloys A, B and C, or when making butt welds in pipe of these three alloys, preheating with the flame will generally bring the material up to a sufficient temperature for welding. The 2-in. flanged bends of alloy C illustrated in Fig. 2 were thus jacketed with $3^1/_2$-in. steel pipe.

Butt welding pipe of Hastelloy alloys A, B and C by the oxyacetylene process can be done without the use of flux, although a special flux supplied by the alloy manufacturer sometimes facilitates the welding operation when used in limited quantities. Many of the ordinary welding fluxes on the market are unsuitable for use, since they may cause a definite loss of corrosion resistance in the weld. Figure 3 shows some typical welded pipe sections spaced out to check size before they are put in chloride service. Iron spacers have been placed where valves will be tied in. This alloy B tubing has all been oxyacetylene welded.

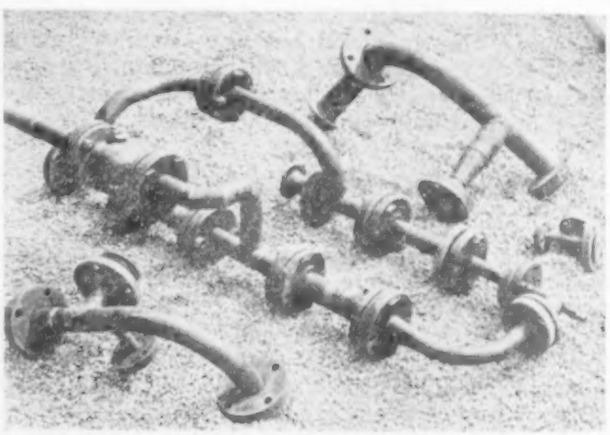


Fig. 3—Fabricated Alloy B Pipe Is Readily Checked Prior to Field Assembly by Putting It Together Using Iron Spacers in Place of Valves

The half-ton cooler inlet sleeve of alloy C, shown in Fig. 4, is being arc welded without preheating. In welding Hastelloy A, B or C castings, corrosion resistance is not lost unless an unnecessary amount of heat is applied or unless the casting is held in a critical temperature range over a several-hour period. Normally it is not necessary to fully anneal the cast material after welding, but if a casting for any reason is left in the furnace too long at a red heat, it may be desirable to fully anneal by the treatment described below.

Oxyacetylene Welding Alloy D

The welding of Hastelloy alloy D is somewhat different from that for the other alloys; welding D is like welding

Fig. 4—Arc Welding of a 1000-Lb. Cast Cooler Inlet Sleeve of Hastelloy Alloy C Has No Effect on Its Final Corrosion Resistance

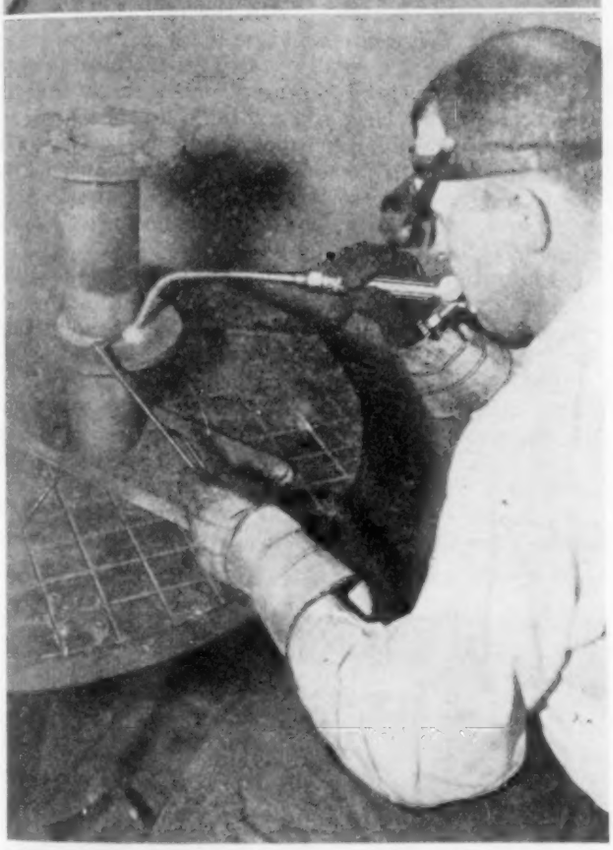


Fig. 5—Hastelloy D Is Always Oxyacetylene Welded. Here a Flange Is Being Welded to a Tank Outlet After Preheating with the Flame

cast iron. Actually, the physical properties of these two metals are very similar, and their melting points are close together, that of cast iron being approximately 2190° F. and that of Hastelloy D, 2060° F. Molten alloy D, like cast iron, is quite fluid so that a welding operator who knows how to weld cast iron should have little difficulty in following the few set rules which should be applied when welding Hastelloy alloy D.

Preheating, to prevent cracking, is most important. All castings of Hastelloy D should be preheated to a temperature of approximately 1400° F., and arrangements should be made to keep the alloy at an even temperature throughout the welding operation. Small pieces such as the flange (shown in Fig. 5), which is being welded to a tank outlet, can be welded by preheating locally with the oxyacetylene flame. Recently, pipe of alloy D up to 3 in. in diameter has been welded by using two oxyacetylene welding blowpipes, one maintaining the heat while the other one does the welding. Pipe larger than 3 in. in diameter, however, should be welded in a preheating furnace. In welding 6-in. pipe, for instance, it is often found desirable to build the furnace around V-blocks so that it surrounds the pipe and extends about 5 in. on either side of the joint. Any kind of a burner—kerosene, gasoline or gas—can be used so long as the pipe is preheated *slowly* at first.

The furnace should, for convenience, be arranged so that welding is done at the top. In preheating, the flame should not be applied directly to the castings at first. The heat should be indirect and slow until the castings reach approximately 800° F., at which point they can be heated much faster. When they have reached a temperature of approximately 1400° F., welding can be started. Because the molten alloy is quite fluid and difficult to weld vertically, it is good practice to weld about 2 in. of linear joint at a time, to allow time for the weld metal to solidify, and then weld another 2 in. If the operator tries to weld this alloy continuously, as if it were steel, the metal may become too hot, and its high fluidity may cause complete lack of control. It may also become gassy, causing porosity in the weld.

When welding has been completed, the preheating burner should be left on until the casting is evenly heated throughout the welded joint. The burner can then be turned off and the welded part left in the furnace to cool slowly. Small pieces, such as pipe, which are not welded in a preheating furnace, should be buried in some substance such as lime, sand or ashes to keep the air from reaching the weld so that it does not cool too rapidly. If such care is not taken—just as with cast iron—cracking is likely to occur.

Welding A, B and C Sheet and Plate

For the fabrication, by welding, of refinery reaction vessels, chemical plant autoclaves, heat exchangers, receivers, stills and tanks made up from sheet and plate of alloys A, B and C, the metallic-arc, atomic-hydrogen and oxyacetylene processes have all been used. From the standpoint of speed, however, the metallic-arc process is preferable. These alloys flow very well under the metallic arc, and form a good-looking weld with a

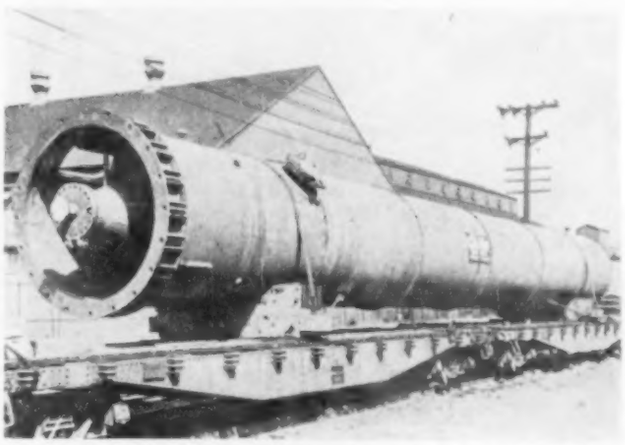
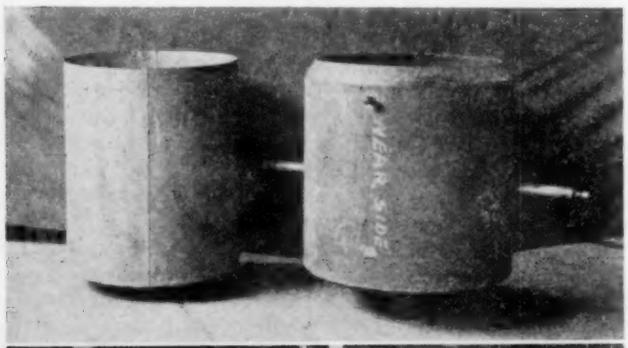


Fig. 6—This Large Isomerization Vessel Lined with Hastelloy Alloy B Is Ready for Shipment, Having Passed All Necessary Hydraulic Tests

Fig. 7—(Left) a Welded Alloy B Liner, and (Right) the Steel Jacket for a 100-Gal. Tank. Such Separate Fabrication with Later Assembly by Welding Is Satisfactory if Hydraulic Pressures Are Not High



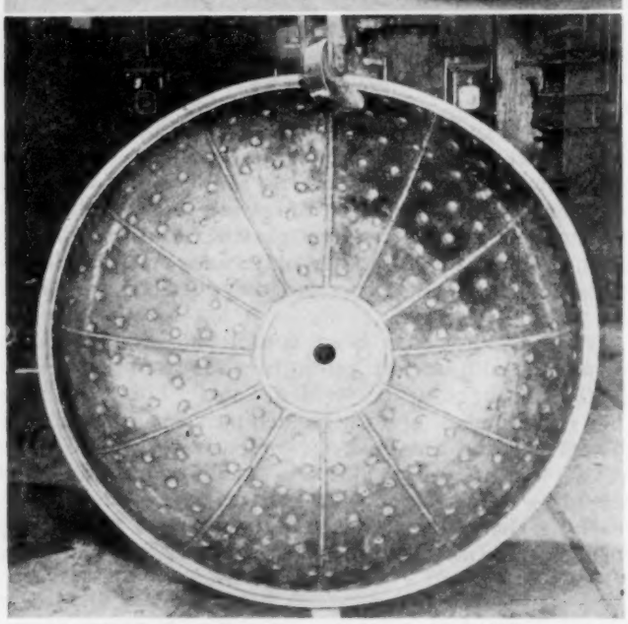


Fig. 8—This Isomerization Tower Head, Lined with Trapezoidal Alloy B Sheets Plug Welded Into Place with Alloy B Electrodes, Is 4 Ft. 8 In. in Diameter

nice cover bead and excellent penetration. In welding with the metallic arc, using reversed polarity on a coated rod, all three alloys flow freely and are likely to be more fluid than under the atomic-hydrogen arc or the acetylene flame.

Weld tension tests made on Hastelloy alloy B have shown that the metallic-arc process gives greater strength than the atomic-hydrogen process. In one example, welds made on this alloy with the atomic-hydrogen process show ultimate strengths of from 91,000 to 97,000 psi. With the metallic-arc process, similar welds showed strengths of between 115,000 and 122,000 psi. In both series of tests, the specimens broke in the welds, and in the specimens welded by the atomic-hydrogen process the weld metal showed a very fine grain structure. Free-bend tests for elongation of the weld metal showed a maximum of 21% elongation on the specimen welded by the atomic-hydrogen process and 22 to 28% on the specimen that was metallic-arc welded.

As with steel, beveling is desirable when welding heavy plate of alloys A, B or C. It is usually preferable to use two fillets, and a double-vee weld is desirable where welding from both sides is possible. If welding can be done from only one side—as in the fabrication of most pipe—a large vee weld should be made with two passes. The first pass with a small rod can fill the bottom of the bevel and obtain the required penetration, and the second pass with a large rod can build up the groove and complete the weld. In making double-pass welds, particular attention must be given to cleaning the flux out of the groove before making the second pass. Peening the welded deposit is not desirable because these materials work harden.

Precipitation occurs in the sheet adjacent to the weld if the metal is held for any length of time within a critical temperature range. This is most noticeable in alloy A, alloys B and C being quite stable. The effect is similar to that obtained when welding unstabilized stainless steel. In arc welding Hastelloy alloys, it is recommended that the welding be done rapidly and with as little current as possible; also, that the arc be choked short and the electrode be worked away from the molten puddle.

If for any reason the metal in a single-vee weld becomes so fluid that it causes beads to form on the inside

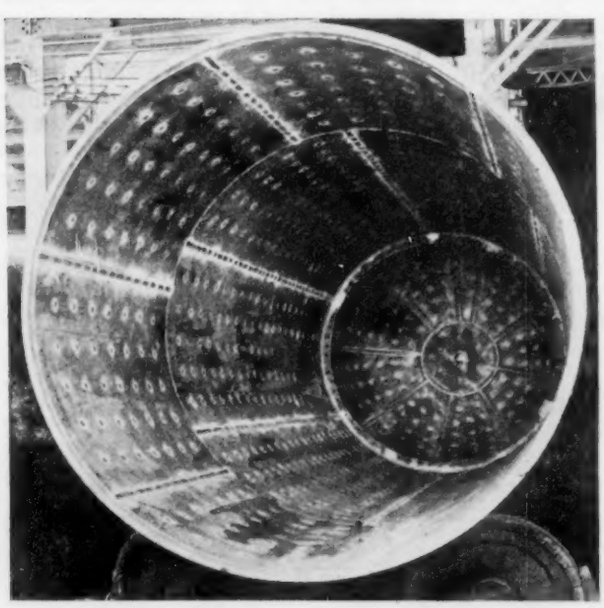


Fig. 9—This Lower Half of One of the Early Isomerization Vessels Lined by Plug Welding with Alloy A Is 36 Ft. Long and 6 Ft. in Diameter

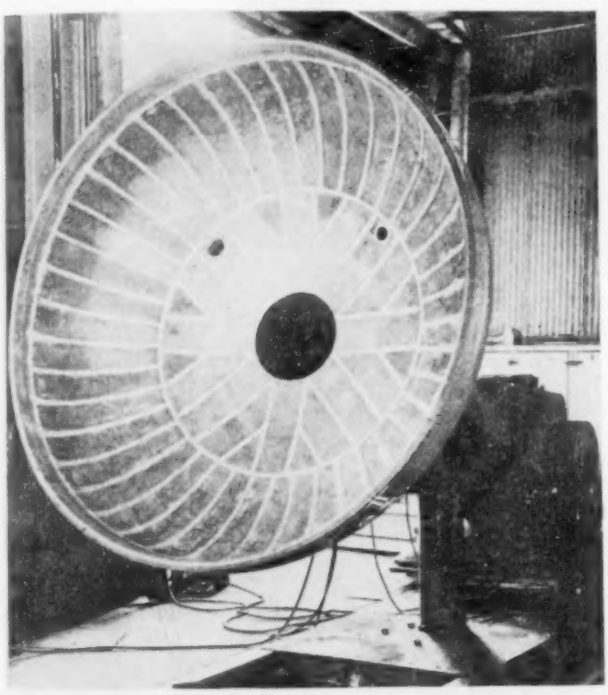
Fig. 10—Tacking Was Eliminated by Using the Fixture Shown Here to Hold the Strips Tight Against the Shell

of seam welds, it may be desirable to employ copper backing-up strips cut with a small groove that allows weld metal to flow through the joint and form a small reinforcing bead on the inside. This is most likely to occur during welding of material of the lighter gages, say, up to $^1/_8$ in. or 11 B.w.g. thickness. If the chill bar is too thick and gives too much of the chilling effect, it may fail to meet its intended purpose.

In one case a double heat exchanger was completely fabricated of 16 B.w.g. sheet. Each of these has 206 tubes, and the tubes, sheets and shell are all of Hastelloy C. They are 10 ft. long.

Porosity in the weld metal is generally a result of overheating, but it is not usually a problem if the precautions mentioned are taken. When porosity is encountered after the arc has been started, sticking the rod to heat it

Fig. 11—A Strip-Welded Tower Head, Lined with Narrow Alloy Sheets



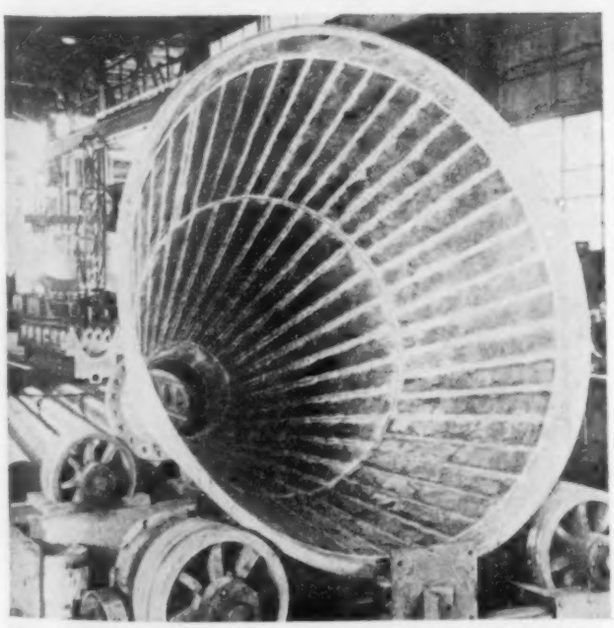
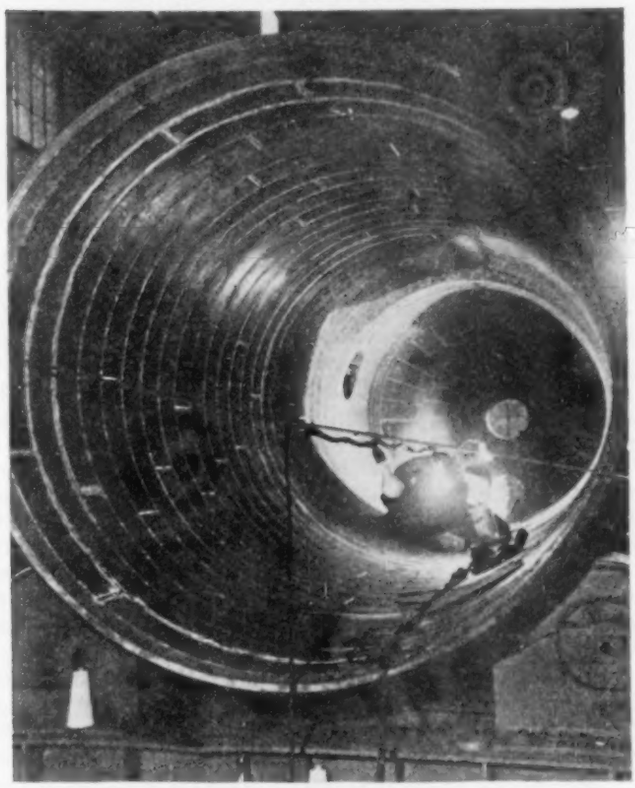


Fig. 12—For Lining the Conical Bottoms of Isomerization Towers, Alloy Strips Are Applied Parallel to the Length of the Vessel

Fig. 13—Trapezoidal Alloy Sheets Tack Welded in an Isomerization Vessel Head Preparatory to Strip Welding



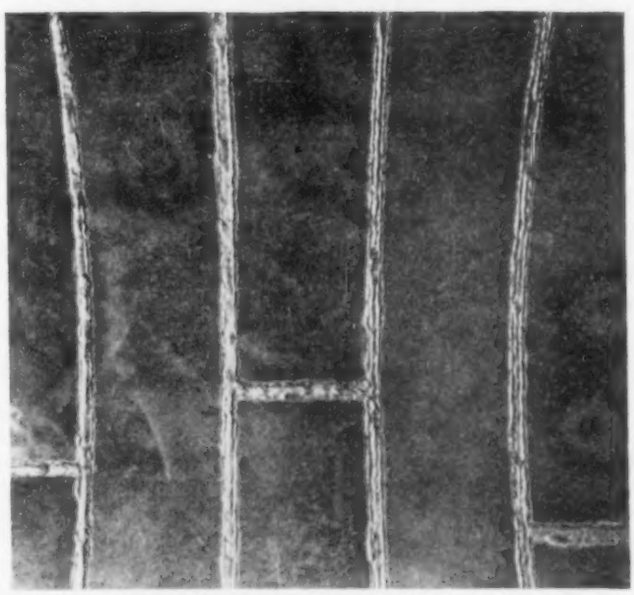


Fig. 14—A Close-Up of Three-Pass Strip Welds. The First Two Fillet Welds Are Left About $^1/_{16}$-In. Apart to Permit the Final Bead to Penetrate the Steel Base

before again starting the arc will eliminate this trouble. It is also desirable to use rods dried in a drying oven to eliminate any possible moisture pickup in the coating from atmospheric conditions.

Wrought alloys A, B and especially C are not so stable as the cast alloys. If the metal alongside the weld is kept in the hardening temperature range for an appreciable time, cracking troubles may occur. In addition, the hardened area of any of the three alloys may be less corrosion resistant. To overcome these difficulties it is sometimes necessary to give the welded part a full or a stabilizing anneal. If annealing is not feasible, the sheet should be purchased in the stabilized condition. The

stabilized sheets are not so ductile as fully annealed sheets, however, and consequently they should be used only when severe forming operations are not required.

Lining with Alloys A and B

The price of these alloys often makes them impractical for use in solid construction of large vessels or high-pressure equipment but they can be used economically for linings. During the past two years considerable lining work has been done with Hastelloy alloys A and B, and a number of different practices have been developed for installing leaktight, corrosion-resistant liners. Liners have been installed in vessels as large as 7 ft. in diameter and 90 ft. high, and operating under pressures as high as 250 psi. The vessel illustrated in Fig. 6 is 7 ft. in diameter and 63 ft. long. It is completely lined with strips of 12 B.w.g. sheet of alloy B.

In the lining work several procedures have been adapted, all of which have some merits and some limitations. It is not the author's intention to pass judgment on the different welding procedures employed for installing liners. Instead, we prefer to point out all the different practices that have been used, so that fabricators and plant designers can decide for themselves which type seems best for the equipment involved.

In the early development work on the installation of liners, no satisfactory arc-welding rod was available, and to overcome this lack quite a lot of work was done with the atomic-hydrogen welding process. The heat of this process often resulted in cracking troubles in the sheet and welds, and the corrosion resistance of the sheet adjacent to the weld was so adversely affected by the heat of the arc that attention was turned to other processes.

On small lined jobs, the practice was first to weld the liner together, as shown on the left side of Fig. 7. Then it was placed in the steel jacket and welded all around the edges. Although this method was satisfactory for small equipment such as the 100-gal. tank illustrated—to be lined with $^3/_{16}$-in. sheet of alloy B—it is not satisfactory for the large vessels needed for the high-octane gasoline program.

Liners First Plug Welded

One of the earliest successful methods used in installing liners was the plug-welding process. Early in the high-octane gasoline program, some liners were installed in new isomerization towers before final assembly. When this was done, the largest sheets within mill limits could be used. Usually, however, linings had to be put in completed steel vessels after they were already in use. Of necessity, the size of the sheets then used was limited by the size of the manway. These sheets varied from 14 to 20 in. in width, depending upon the individual vessel, and all the sheets were preformed to the curvature of the vessel. For plug welding, some were perforated with slots $^1/_4$ in. wide and 1 in. long, and others were drilled with $^5/_8$-in. or $^3/_4$-in. diameter holes, the slots or perforations being spaced from 4 to 6 in. apart. The sheets were installed longitudinally and were plug welded to the steel and fillet welded around the edges.

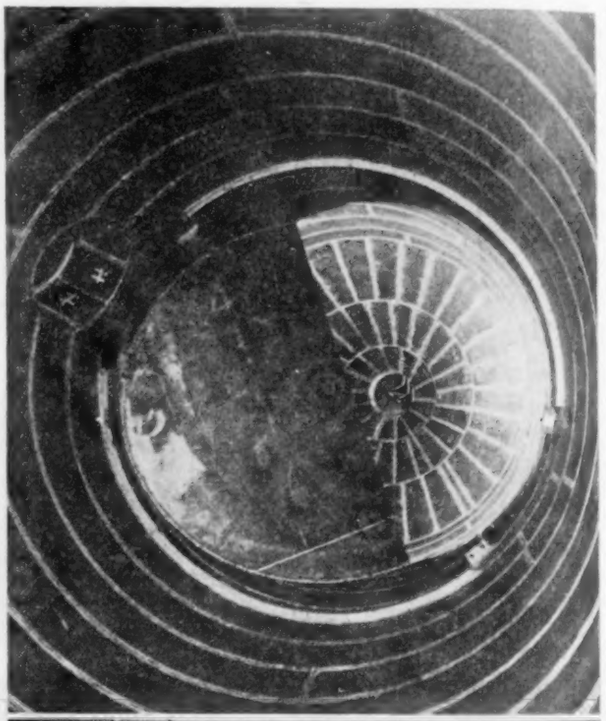
Heads were lined, using trapezoidal sheets approximately 4 in. wide on the large base and 1 in. wide on the small base, and varying in length depending upon the size of the head. The head shown in Fig. 8 was plug welded in this manner, using alloy A sheet 0.075 in. thick and alloy B electrodes. It has a diameter of 4 ft. 8 in. and is being used on a vessel 70 ft. high. The nozzles were lined with cylinders rolled from sheet, inserted in the nozzle and welded to the nozzle at each end. The faces of the flanges were covered with a Hastelloy alloy ring either cast or cut from sheet.

Considerable work was done in attempting to line these vessels in position—welding the liners in the field—but without success. While some position welding can be done with these alloys, using the metallic-arc process, welding large installations in position is difficult since the present rods in both alloys B and C are too fluid for satisfactory results. Work is being done on developing a more satisfactory rod for position welding.

Because of this fluidity, tanks or towers already in service must be taken down, so that the welds can be made in a downhand position.

Field welding was just a stopgap—necessary in the

Fig. 15—Final Assembly of the Bottom of Each Tower Includes Welding the Hastelloy Alloy Baffle Plate in Place and Lining the Outlet



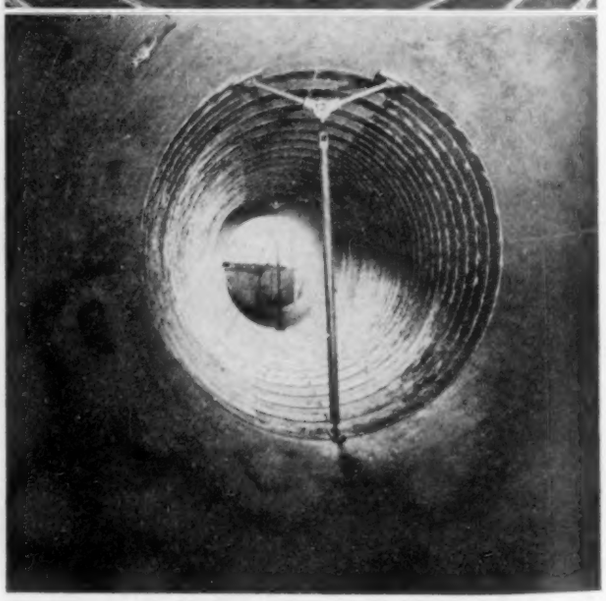


Fig. 16—Turnbuckles Are Used Here to Hold the Sheet Tight Against the Shell During the Lap Welding

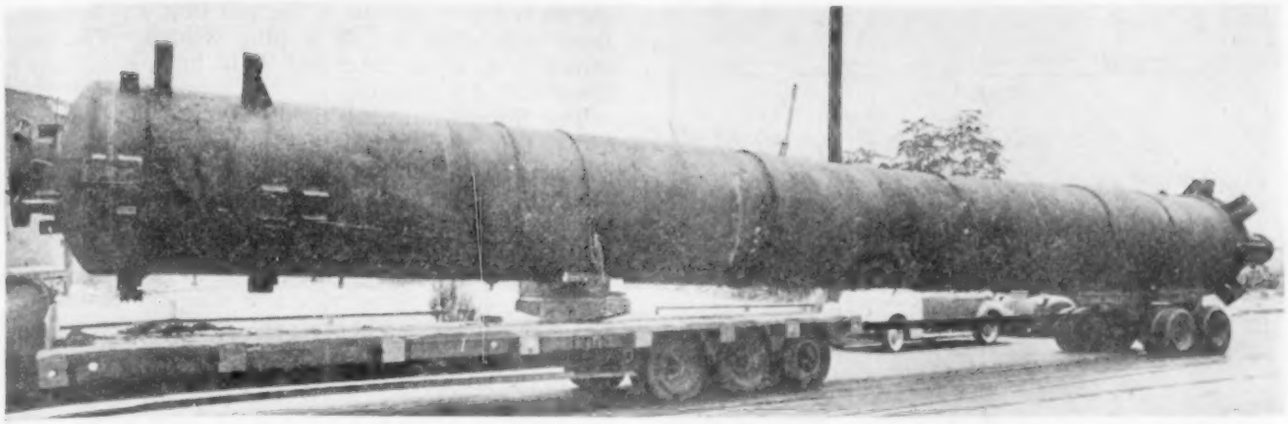


Fig. 17—A Completed Isomerization Tower Ready for Shipment After Having Passed the Stringent Hydrostatic and Ammonia-hydrogen Chloride Tests

early part of the high-octane gasoline program only because steel equipment proved unable to withstand the corrosion of the chemicals involved, and something had to be done quickly. Those concerns that ordered lined vessels direct from the fabricators gave the fabricators a better opportunity to apply their best techniques.

An Eastern concern that had had long experience with the fabrication of these alloys was first called upon to install alloy A linings in the lower sections of new vessels. These sections ran from 15 to 20 ft. high. They employed 12 B.w.g. sheet perforated with $^5/_8$-in. diameter holes, 6 in. apart. These sheets were formed as closely as possible to the inner contour of the vessel and held tight against the wall of the vessel with jacks during welding. The welds were made in two passes, the first with flux-coated B electrodes by the metallic-arc process, and the second with bare rod by the atomic-hydrogen process. The initial pass tied the alloy sheets to the steel and the second pass assured a sound deposit on the surface to be exposed to the chemicals. The plug welds, of course, consisted mainly of filling the perforations. For the seam welds, the sheets were spaced $^5/_{16}$ in. apart and the groove filled.

After this type of welding, each vessel was stress relieved at between 1100 and 1200° F. Then two test holes were drilled in the steel shell under each alloy sheet, so the liner could be tested by 15 psi. air pressure. If the lined sections were all right, they were sent to other fabricators, who welded them to the steel upper section, and installed cast nozzles by projecting them directly through the lined steel wall, and welding them to the lining on the inside and to the steel on the outside. Manways were lined with sheet in the same manner as the main vessel.

Following this, some vessels were lined with 14 B.w.g. Hastelloy alloy A sheet, plug welded with Hastelloy C rod. This rod had better welding characteristics than the alloy B rod then available and the combination passed the tests for satisfactory corrosion rates.

Alloy B Now Used for Linings

Just about this time, a new coated B rod was developed for metallic-arc welding. This did away with the need for making a cover weld with the atomic-hydrogen arc

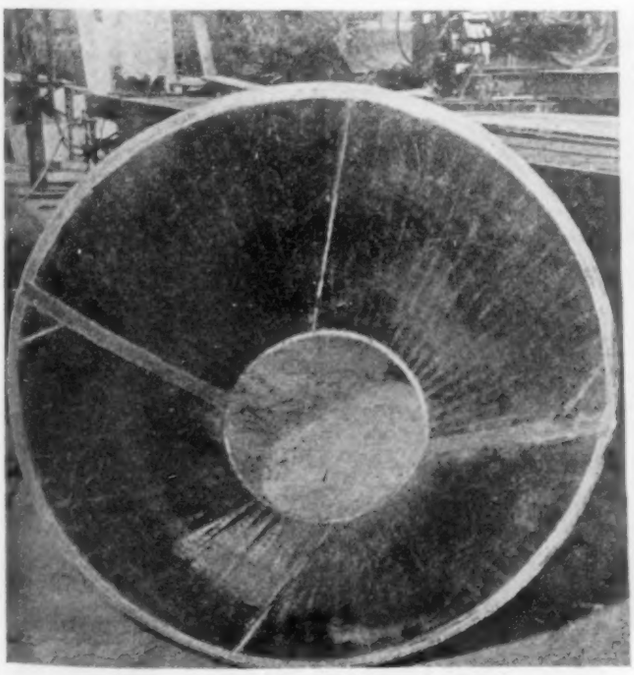


Fig. 18—The Third Method of Lining—Resistance Welding—Has Been Applied to This Conical Tower Bottom

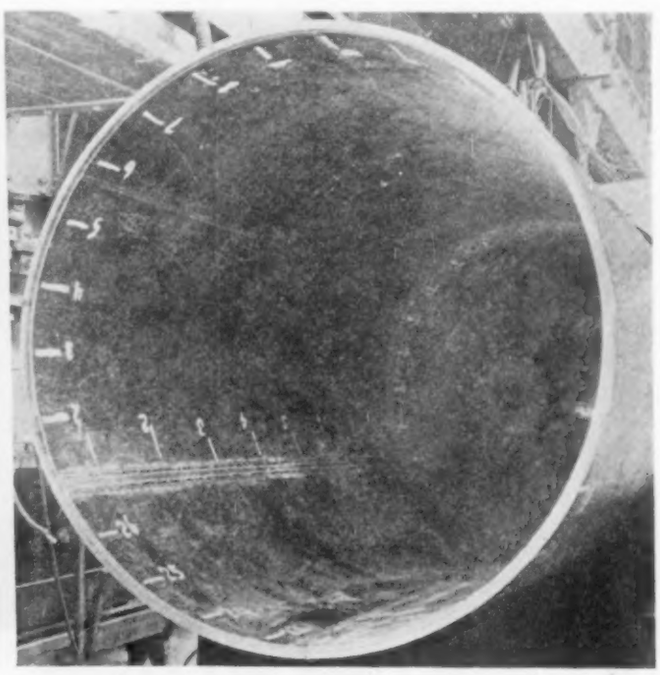


Fig. 19—This 70-Ft. Isomerization Vessel Has Been Lined with Hastelloy Alloy A by the Resistance-Welding Process

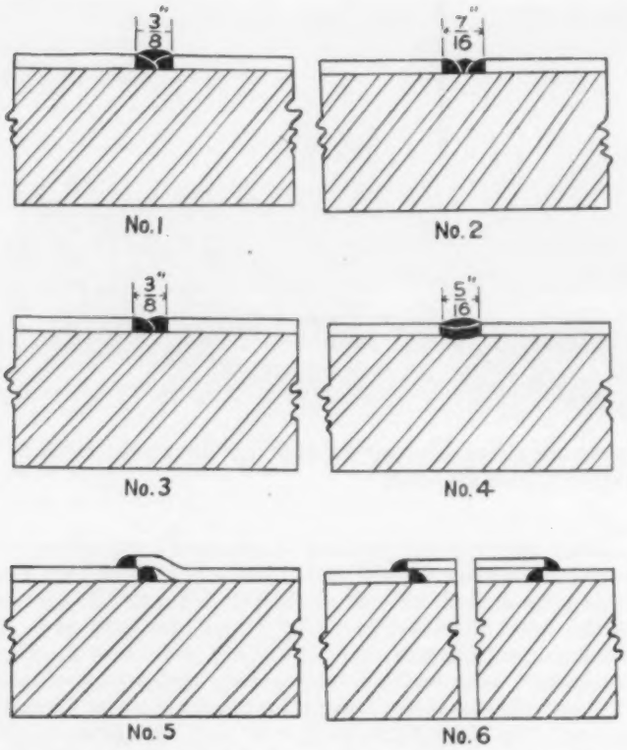


Fig. 20—These Are Some of the Techniques Developed by Fabricators of Hastelloy Alloys from Their Experiences of the Past Two Years

and resulted in porosity-free welds. At about the same time most of the oil refineries decided to use alloy B sheet in place of alloy A, and it was also found best to have the complete area of the interior of these vessels lined.

Accordingly, over 40 of these large vessels have been built and some of the first have now been in service over two years. Plug welding has been used by several fabricators, and experience in this type of work has shown that a few tricks of the trade are all that is necessary to produce a satisfactory job. The vessel interior shown in Fig. 9 was one of the first that was successfully lined with alloy B. It is plug welded. The section shown, 6 ft. in diameter and 36 ft. long, is actually the lower half of a tower.

The linings must fit tightly to the steel case. To assure this, the lining is held in position with shoes or supports to prevent the heat of welding from warping the liner away from the base metal. Generally, the sheets are fitted in place and held with shoes. As an additional precaution, they are tack welded in place before plug or seam welding. In the early plug-welded construction, some contraction and warpage of the lining was encountered. The warpage caused a few linings to pull loose from their steel backings. This, of course, was due to the large size of sheets employed and the resultant increase in stress.

In one instance, a fabricator corrected this trouble by corrugating the sheet between the longitudinal rows of plug welds to allow sufficient slack to provide for the contraction of the welds. This did not, of course, correct longitudinal shrinkage, but the longitudinal effect could be offset somewhat by starting the welding at the center of the sheet and working toward the ends. The corrugations of the welded sheets were then hammered out with a flatter. This practice resulted in some work hardening of the material during the flattening operation. Although such work hardening would be undesirable in the most severe type of corrosive service, it was not great enough in this instance to spoil the linings for the high-octane gasoline service, and the liners did not draw away from the shells.

Strip Welding Developed

Strip welding was the second process employed for installing these big linings. In this process, narrow sheets—varying in widths from 4 to 6 in.—are welded all along the edges directly to the steel shell. With this practice, it is usually easier to hold the liner tight to the steel. Figure 10 shows a section of a 7-ft. 6-in. diameter vessel partially lined with 12-gage Hastelloy alloy B, and the fixture used to hold the strips tight against the

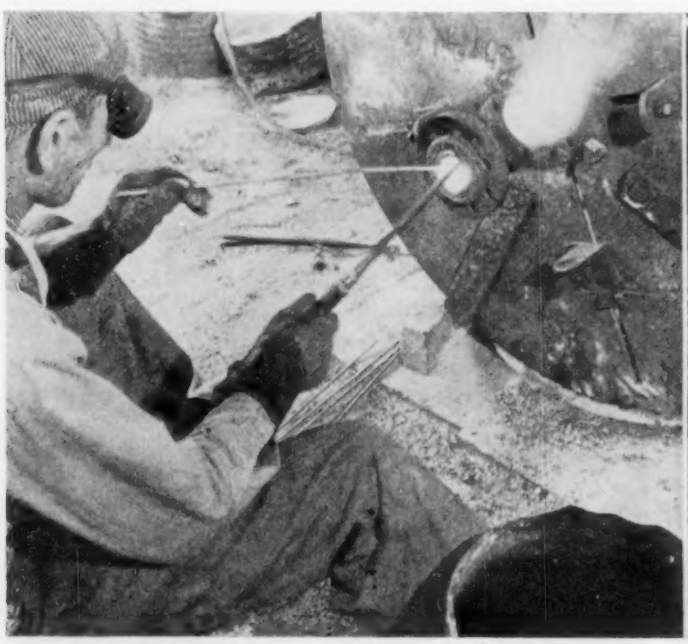


Fig. 21—Application of Hastelloy Alloy B as a Corrosion-Resistant Surfacing to Parts Such as Used Steel Valves Is Readily Made by the Oxyacetylene Process

Fig. 22—Coating a Valve Plug with Alloy B. Such Corrosion-Resistant Surfacing Is an Economical Method of Reclaiming Used Refinery Equipment

shell. It was later found that tacking could be eliminated through the use of this fixture. Figure 11 shows a head so lined by strip welding. The principal problem here had to do with the best procedure for making the seam welds. On the plug-welded jobs, most had a two-pass weld on the seam, with the individual sheets placed so that the longer edge was parallel to the height of the vessel, and spaced close together. A number were, however, done in three passes.

For strip welding the conical bottoms, the strips are applied parallel to the length of the vessel as shown in Fig. 12. In the main section of the vessel, however, they were applied with the long dimension running circumferentially. The latter method has been more successful.

In lining up the strips the vertical joints are staggered and the strips must be exactly parallel and follow the true circumferences of the vessel as shown here. As soon as the lining strips are fitted snugly in the vessel, they are tacked in place with a sufficient number of tack welds to keep the liner tight against the steel while the final weld is being made. The tacks are visible near the welding operators in this view. Lining the conical or dished heads is done in the same manner, as can be seen in Fig. 13 where the trapezoidal plates are shown tacked in the head of the vessel.

In making the strip welds all welding is done in a downhand position. For two-pass strip welding, the spacing is approximately $^{3}/_{16}$ to $^{1}/_{4}$ in. between the strips. This method puts less heat into the sheet metal adjacent to the weld and also does not require so much welding rod as the three-pass method. On bursting tests of sheet welded to heavy steel plate, the strength of the two-pass welds was somewhat stronger than that of the three-pass welds, which is probably accounted for by the fact that there is less heat applied to the sheet and therefore less hardening of the weld-affected zone.

For three-pass welding, the strips are spaced $^{3}/_{8}$ to $^{7}/_{16}$ in. apart, so that a fillet can be made between the edge of each sheet and the base metal, and then a filler pass made over both fillet welds. A close-up of such a weld is shown in Fig. 14. The spacing between the bottom of the two original fillet welds should be about $^{1}/_{16}$ in. to permit the final fill-in weld metal to fuse to the steel base metal. The fill-in weld is, of course, made only after the adjacent fillet welds have been thoroughly cleaned and checked for defects, such as porosity, lack of fusion or liner cracks. Figure 15 is a view toward the bottom of one of the lined vessels showing the baffle in place and an outlet at the lower left. Figure 16 shows a view of a lap-welded section of a 4-ft. diameter by 40-ft. long vessel that had been lined with 14-gage Hastelloy alloy A strips 6 in. wide. Note the ingenious use of turnbuckles to keep the sheet tight against the steel shell during welding.

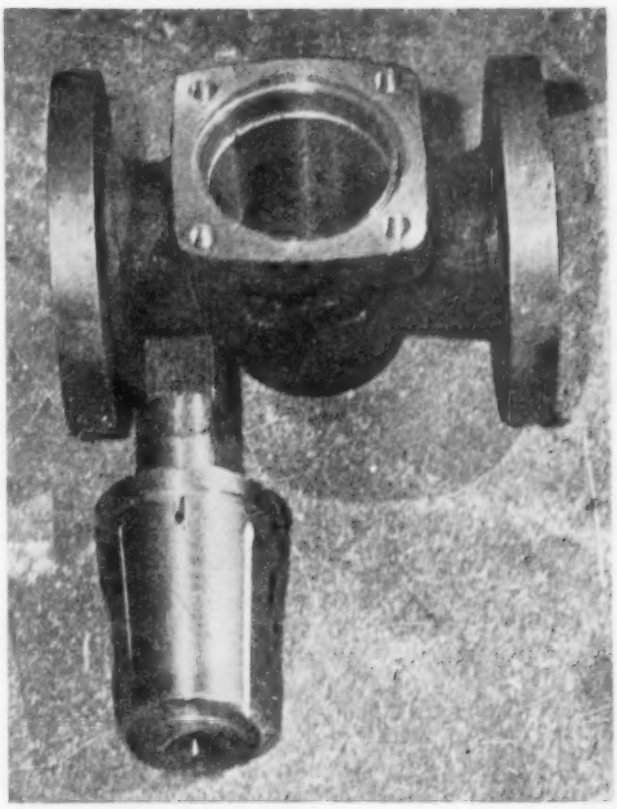


Fig. 23—Various Valve Parts Reclaimed by Corrosion-Resistant Surfacing with Welded-On Coatings of Hastelloy Alloy B

Test Procedures Point Way to Improved Technique

In both plug and strip welding, porosity and cracks in the welds occasionally caused difficulty. Testing for leaks also gave some difficulty, especially when they occurred between the liner and the steel, since it was frequently possible to check for leaks on the lined sections with air pressures as low as 15 to 30 psi. This low air pressure would not reveal leaks that might occur if the equipment were subjected to 500 to 750 psi. hydrostatic pressure. The size of the problem is evident from Fig. 17, a view of a completed vessel. A more sensitive test has thus been developed wherein hydrogen chloride gas is pumped under 5 to 10 psi. pressure between the liner and the steel. The inside of the vessel is then swabbed with ammonia, which produces a white cloud at the point of leakage. This test seems to be much more sensitive than the usual air and soapsuds test.

As a result of the hydrogen chloride-ammonia test and the high hydrostatic pressure tests, a number of advantageous precautions were discovered for the seam-welding procedures for alloy B rod used on the edges of sheets applied by both the plug and strip methods. It was again emphasized that the steel should be thoroughly cleaned and the Hastelloy alloy strips have to be held very tightly against it, not only to produce a tight job, but also to dissipate the heat from welding more rapidly. It was found that a short arc was best for producing the lowest possible heat. In fact, a current of only 90 amp. at 25 volts should be used with the $^{3}/_{32}$-in. diameter rod, and 120 amp. at 27 volts is sufficient for the $^{1}/_{8}$-in. rod. To minimize the heat further, the rod or electrode must be directed almost entirely onto the steel plate and only the edge of the arc should burn into the Hastelloy alloy sheet or strip.

Resistance Welding Also Satisfactory

Development work on the third method of lining vessels—with resistance welding—has now progressed to such a point that alloy A is now being applied to steel vessels in much the same way as stainless steel is used for lining. Figures 18 and 19 show a resistance-welded bottom cone and a 70-ft. vessel completely lined with alloy A by this process. The resistance-welding process now produces very satisfactory linings of Hastelloy alloy A even in such big units as that shown in Fig. 19.

Little has been said in this discussion about lining vessels with alloy C, but such work as has been done with this alloy would indicate that it can probably be handled as readily as the other two alloys, and by more or less the

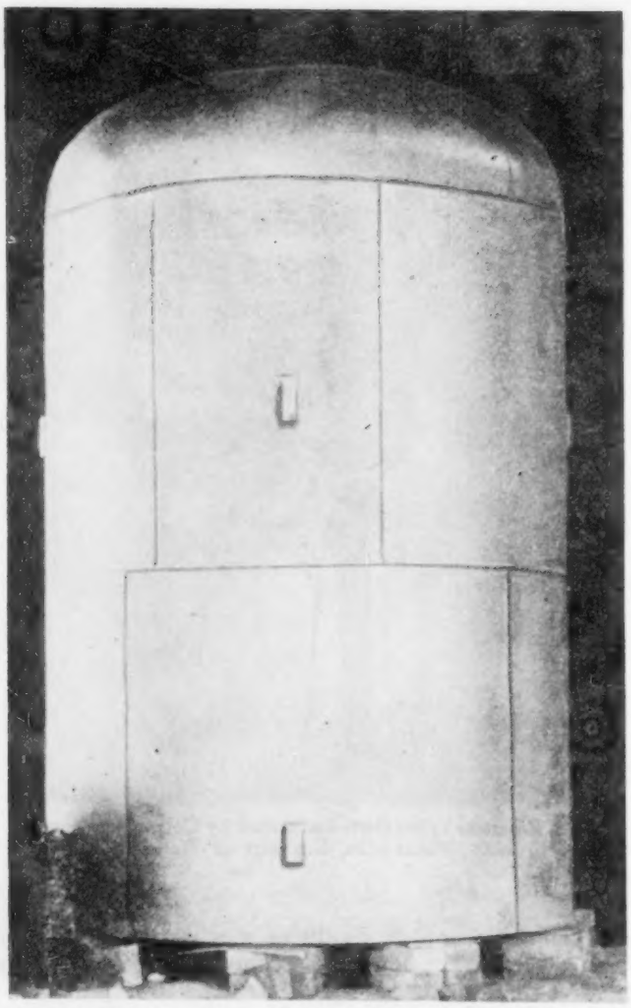


Fig. 24—This Liner for a 1200-Gal. Autoclave Was Fabricated of 1/4-In. Thick Hastelloy Alloy Plate, Then Fully Annealed

same techniques. Increased experience in lining vessels lined with alloy C will certainly iron out any difficulties.

So much experience has been gained in handling Hastelloy alloys in the past two years that the fabricators working with them now have their techniques well developed. Several of these are indicated in Fig. 20. The first method indicated is a three-pass weld, two fillet welds attaching the strips to the shell, with a third pass completely covering the two fillet welds. This cover bead has been found very advisable as some exposed fillet welds have been attacked, due to iron pickup. Number 2 is the originally recommended three-pass seam weld, showing how the uncovered fillet welds with high iron content could be corroded through to the shell; Nos. 3 and 4 show two types of double-pass seam welds; No. 5 shows shingle-welded seam; No. 6 shows lap-welded seam.

Because of the growing demand for equipment of Hastelloy alloys in the chemical industry, other fabricators will undoubtedly enter the business.

Welded Linings Applied to Valves

Although sheet has been used for lining many large pieces of equipment, welded facings are being used for smaller parts, such as valves. Many hundreds of valves have been salvaged since the start of the war for one particular service requiring an alloy resistant to hydrochloric acid and aluminum chloride. If care is taken to get a clean surface on the steel valves, the port, throat, seat and plug can all be coated with Hastelloy C or Hastelloy B using either the oxyacetylene or the metallic-arc process. Dependent upon the type of steel being employed for the base metal, preheating to from 600 to 1200° F. is necessary, and the parts being coated should be kept at temperature all during the welding period. Of course, on the larger valves maintaining an even temperature in the neighborhood of 1000° F. is essential to avoid cracking the deposit. Proper jigs are also advisable so that all welding can be done in the down-hand position. After coating, the parts are cooled in still air. Valve parts thus coated (Figs. 21, 22 and 23) have demonstrated excellent economies in service.

Anneals Maintain Corrosion Resistance

Since full corrosion resistance is developed after welding only by heat treatment, a word should be said about the heat treatments for these alloys. Heat treatment is not necessary, of course, when the equipment is to be exposed only to mild forms of corrosion. But where corrosion is a particular problem—and it is for that sort of service that Hastelloy alloys are especially efficient—heat treatment is usually necessary even if the equipment is large. An example of this is the liner for a 1200-gal. autoclave (see Fig. 24) which was welded of 1/4-in. plate and then fully annealed.

Only two of the standard heat treatments will be mentioned. They are called the "full anneal" and the "stabilizing anneal." All Hastelloy alloy A, B and C sheet and plate is furnished in the fully annealed state unless otherwise specified. This anneal produces softness, toughness, machinability and high corrosion resistance. On Hastelloy alloys A and B a "full anneal" consists of holding at a temperature of 2100 to 2150° F. for 20 min. to 1 1/2 hr., depending upon the thickness, and cooling rapidly in air or quenching heavy sections in water. For Hastelloy alloy C, the temperature is a little higher—2200 to 2225° F.—for 2 to 3 hr. according to the section, and rapid air cooling is used. Such a treatment is similar to the softening of austenitic steels—namely, holding at heat and then cooling rapidly.

The stabilizing anneal is frequently used before welding A, B or C sheet to prevent deterioration adjacent to welds, when heat treatment after welding is not practical. It is also used after welding to reduce the loss of corrosion resistance and toughness that may result from exposure of a part of the welded structure to temperatures between 1200 and 1900° F. This treatment is most effective when preceded by the full anneal. For alloys A and B, it consists of holding for 2 to 4 hr. at a temperature between 1925 and 1950° F. and air cooling. Alloy C should be held for the same time at the higher temperature of 2050 to 2075° F. and also cooled in air.

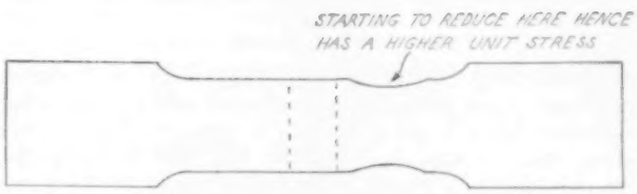
In conclusion, any competent welding operator can become proficient in welding these alloys, and by taking advantage of the experience already gained in the work described he can turn out a job that will measure up to the most exacting standards.

The Restriction of E6012 Electrodes*

By Omer Blodgett†

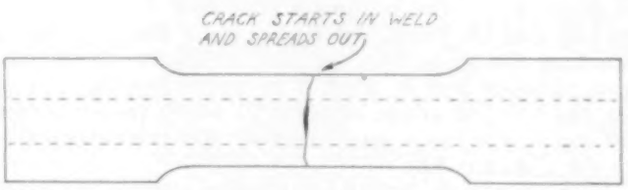
IN THE earlier days of electric welding when it was difficult to make a strong weld using bare electrodes, the thought uppermost in our minds was strength. Can we make this joint as strong or stronger than the base metal? This thought was also a carry-over from the riveting practice wherein the joints were always weaker than the base plate because of the rivet holes cut in the plate. We came to accept the fact that the joint was weaker than the remaining plate, and we designed our structures accordingly. We were always striving to make welds which had a strength greater than the base plate; later coated electrodes were developed which gave greater strength and soon good welders were able to make a welded joint, which when pulled transverse to the weld would fail outside of the weld. We had reached what some thought was the final goal in welding. Most of us labored then under a false illusion that the only requirement of a good weld was that it have greater strength than the base metal. This period in welding could be called the age of strength, because that was the belief at that time.

Just a few years ago, some men began to question this. They found that these welded joints when pulled, broke outside of the weld not because the weld had a higher strength, but because it had a higher yield point, see Figs. 1 and 3. When the joint was pulled, the base metal near the weld underwent plastic flow or elongated before the weld, because its yield point was reached first. Because of this elongation, the base metal reduced in cross-sectional area much more than the weld. Now the weld and the base metal are subject to the same load, but because the base metal now has less cross-sectional area, it has a higher unit load or stress. This higher stress in turn causes more elongation and reduction in area of the base metal; finally this material breaks outside of the weld. After the base metal once starts to reduce in area, the weld itself is safe, because now it has a larger cross-sectional area than the base metal, resulting in lower unit stress. It was some time before the welding industry accepted this newer idea. To give further proof, these welded butt joints were pulled longitudinally with the weld. Elongation values taken showed that, in general, the weld metal had slightly lower ductility than the base metal. When these specimens were pulled, the weld metal having a higher yield point could not stretch as much as the more ductile base metal and therefore broke first; the crack then spread across the specimen, Fig. 2. We came to accept this idea that a good weld must have ductility in addition to strength, and this may be termed the age of ductility in welding. We are still in this period of ductility and perhaps will never quite get out of it.



PULLED TRANSVERSE TO WELD

Fig. 1



PULLED LONGITUDINALLY TO WELD

Fig. 2

Ductility is still very important in good welding practice, but in some cases we are overdoing the extent to

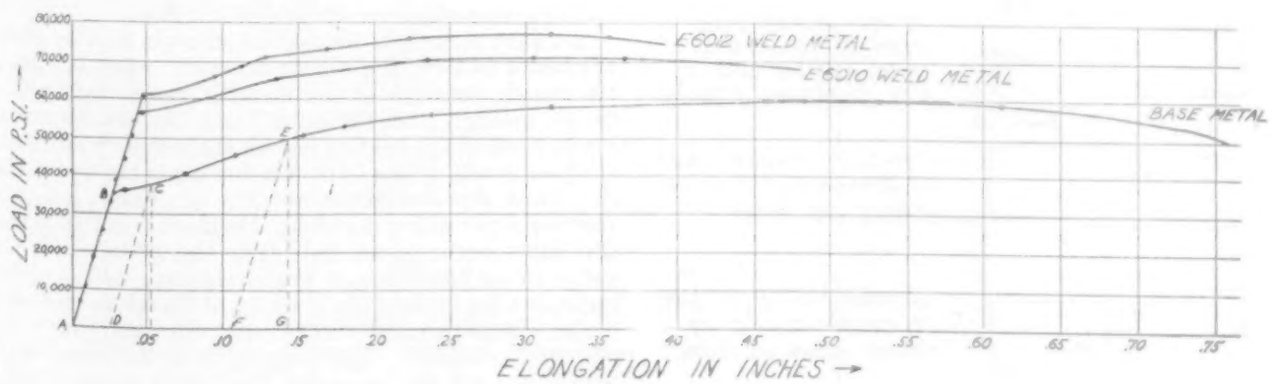


Fig. 3

* Presented before the Minneapolis Engineering Club, Minneapolis, Minn., March 19, 1944.

† Welding Superintendent, The Globe Shipbuilding Co., Superior, Wis.

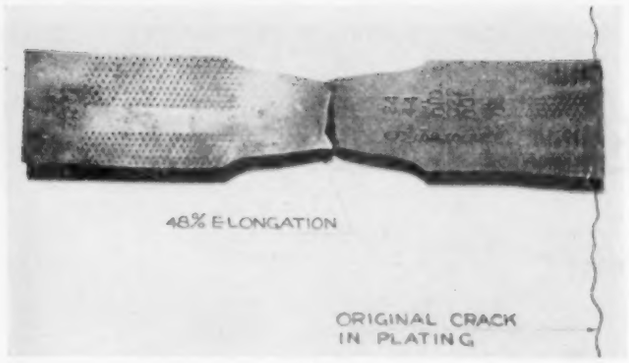


Fig. 4

which ductility should be emphasized. Let us consider the stress-strain diagram of mild steel and see just what happened when a piece of steel is stressed, Fig. 3. We notice when a load is placed on the steel it elongates, this elongation or strain being proportional to the stress applied, providing this does not exceed the elastic limit. This is in accordance with Hooke's law and represents the regional between points *A* and *B*. If the loading is removed the metal will come back to its original length at point *A*. If the loading is continued above point *B* we find that the metal undergoes plastic flow, and during this time the stress does not increase much. If the load were removed here at point *C* we would drop back along the line *CD* and arrive at point *D*, which shows us that the metal now has a permanent set which is represented by the distance *AD*.

Now suppose we have a plate which contains a locked-up stress of perhaps 50,000 psi., representing in this case a deformation taking it beyond its practical usefulness. This is represented by the point *E* on the stress-strain curve. We find from this diagram that if this stress were removed, the metal would contract 0.0017 in. per inch or a contraction of 0.17%, and would come back to point *F*. This contraction is represented by the distance *FG*. This value can be computed by dividing the stress of 50,000 psi. by the modulus of elasticity which is 30,000,000 psi. and gives us a 0.0017 in. per inch. The line *EF* along which the contraction took place while the load was reduced is parallel to line *AB* which is our modulus of elasticity for the steel. In other words, regardless of the load applied or the amount of elongation already taken place, it only takes a very minute yielding to bring the steel down to zero stress. With this locked-up stress of say 50,000 psi., we need a yield of only 0.17% in the adjacent metal in order to eliminate this stress. If we were making welded joints which would have to be formed or be severely bent, then it would be necessary that the weld have an elongation of perhaps 20 to 30%, depending upon the amount of deforming necessary. However, in ship construction we are not designing for such severe movement. We need only a weld having sufficient size to withstand a certain load and with sufficient ductility to yield in order to relieve any internal stress. Who is going to say then that the weld metal must have a minimum elongation of 22%, or that weld metal with 17% elongation, such as the E6012 electrodes is not sufficient? I do not mean that 0.2% elongation is sufficient for weld metal, but under the conditions mentioned, weld metal capable of 17% is more than sufficient.

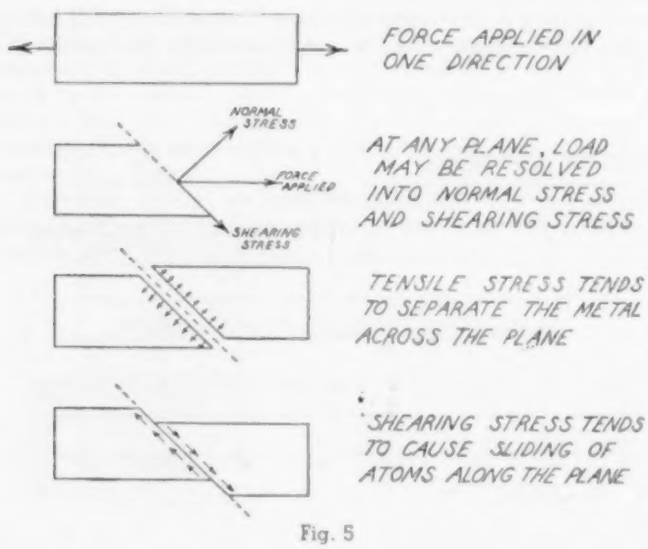

FORCE APPLIED IN ONE DIRECTION
NORMAL STRESS
FORCE APPLIED
SHEARING STRESS
AT ANY PLANE, LOAD MAY BE RESOLVED INTO NORMAL STRESS AND SHEARING STRESS
TENSILE STRESS TENDS TO SEPARATE THE METAL ACROSS THE PLANE
SHEARING STRESS TENDS TO CAUSE SLIDING OF ATOMS ALONG THE PLANE

Fig. 5

There are some who understand that under certain conditions of loading such as multiaxial stresses or stresses in more than one direction, it is difficult for metals to elongate, and therefore they may fail in a brittle manner, but they erroneously believe that this is more reason for the metal to have higher ductility. This is not true; a metal under this severe condition of multiaxial stresses will fail whether it has good ductility or poor ductility. Figure 4 is a tension specimen of a piece of shell plate which under multiaxial stresses on the ship cracked in a brittle manner, and yet when this specimen was later pulled, it showed the metal to have an elongation of 48% in 2 in. One could not ask for a more ductile metal, and yet it failed in a most brittle manner on the ship.

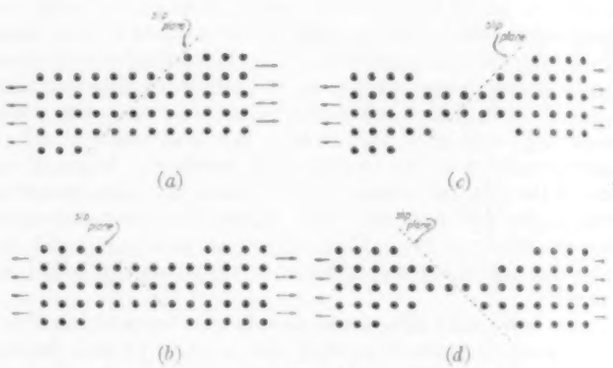


Fig. 6

Any force applied to a metal may be resolved into two components, a normal stress and a shearing stress, Fig. 5. The normal stress may be tensile or compressive and tends to separate or compress the atoms across a plane of the metal. The shearing stress tends to shear or cause the atoms of iron to slide past each other along this plane. The normal stress tends to cause the metal to fail by pulling apart, while the shearing stress causes a sliding action which results in a plastic flow.

We have seen that this normal stress in no way allows the metal to flow in a plastic manner; when it exceeds the tensile strength of the metal it causes failure in a brittle manner. On the other hand, the shearing stress component of the loading causes the metal to slip along slip planes and results in plastic flowing of the metal, Fig. 6. When slip does occur along a slip plane, a certain resistance to further slip along this plane is set up so that slip must occur along the other slip planes. This is called strain hardening or work hardening and since this resistance for further slip is set up, it therefore requires a higher stress to cause further slip; in other words, its strength increases. This slip, resulting in plastic flow, continues until the increasing load which causes the slip now is built up to the value of the maximum tensile

strength or ultimate strength of the metal at which time failure occurs.

In a simple loading of a metal specimen, the maximum normal or tensile stress acts on a plane at right angles to the line of loading; the maximum shearing stress resulting from the same load acts along a plane at 45° to the line of loading. This is shown in the drawing on the right-hand side of Fig. 7. It can be shown mathematically in this example of loading that the maximum shearing stress has a value of one-half of the loading stress, and the maximum normal stress has a value equal to the loading stress.

Consider for a moment this piece of metal subjected to tension in one direction only. We may take a small square of the metal and rotate it, and study the corresponding stresses which this small area is subjected to at these various angles. We notice when the angle of the reference plane is zero, that is, at right angles to the line of loading, that the plane is subjected to pure tension and no shear, the tensile stress being equal to the loading stress. If this plane is rotated 45° we obtain our maximum shearing stress which happens to be equal to one-half of the loading stress. This can also be shown graphically by means of Mohr's circle of stress which is in the left-hand side of the drawing. Here the maximum normal stress on a plane at right angles to the line of loading, or angle 0°, is represented by the point A on the X axis; the maximum normal stress on the plane in the line of loading or 90° which in this case of pure tension is zero, is represented by the point B at the center of the ordinates. With these two points a circle is drawn with center at C which is halfway between points A and B. Through this center C we pass a reference plane and rotate it through any angle. This plane corresponds to the same plane in the metal, the only difference being that its angle of rotation is just twice that of the plane in the metal. In other words, if we rotate the plane in the metal through an angle of 45° to find the value of the maximum shearing stress, we must rotate the plane in the circle of stress through an angle of 90°. When we do this we find the value to be point D on the circle which happens to be one-half of the value of the maximum normal stress at point A.

Now we will tabulate the resulting maximum normal stresses and the maximum shearing stresses according to increasing values of load applied, keeping in mind that this metal has a definite tensile strength or ultimate strength, and that shearing stresses applied to the metal cause it to flow in a plastic manner as a result of slippage along numerous slip planes. In every type of loading there is a certain relationship existing between the shearing stress component and the normal stress component of the loading. This relationship for a particular type of loading is constant throughout the entire range of loading and is represented by a line, the slope of which is determined by this relationship. The shearing stress component is represented by the vertical axis, and the normal stress component by the horizontal axis. In this case the shearing stress component is always equal to one-half of the normal stress component, which is represented by the line A in Fig. 8. For any value of the load, we may read the normal stress component or read the shearing stress component. As the load is increased these two components will increase proportionally. For every metal there are certain maximum or critical values for the shearing stress and the normal stress. When the

Fig. 7

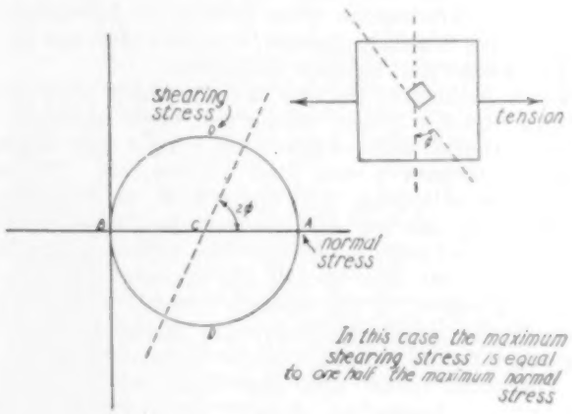
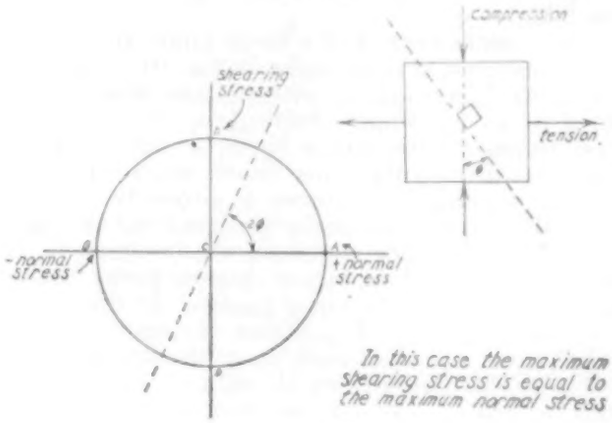

shearing stress
tension
normal stress
In this case the maximum shearing stress is equal to one half the maximum normal stress

Fig. 9


compression
shearing stress
tension
- normal stress
+ normal stress
In this case the maximum shearing stress is equal to the maximum normal stress

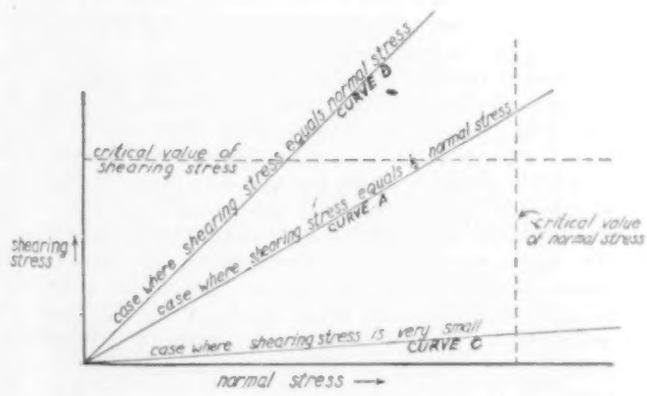


Fig. 8

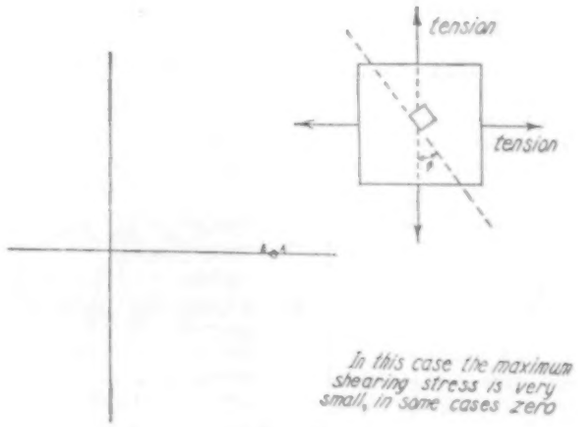


Fig. 10

critical shearing stress is exceeded, plastic flow takes place; when the critical normal stress is exceeded, fracture takes place. As the load is increased elongation in the form of elastic action takes place. As the load is further increased the shearing stress component and the normal stress component likewise increase until the shearing stress component exceeds its critical value and plastic flow takes place resulting in much elongation. Slip along numerous slip planes takes place resulting in a gradual necking down of the specimen and equally as important, an increasing of the metal's resistance to shearing or its shearing strength. If this strain hardening did not take place, slip would merely result in the specimen quickly flowing out to a knife edge and failing immediately without any appreciable increase in strength, but because of a strain hardening, we are able to continue the loading. This loading can be further increased, resulting in further plastic flow or elongation until finally the critical value of the normal stress is reached at which time failure occurs.

Consider now the case of a metal subjected to tension in one direction and compression in the other, or at right angles, in Fig. 9. Point *A* in Mohr's circle of stress represents the tensile stress at zero angle. Point *B* represents the compressive stress at 90°. Both of these are the normal stresses. Point *B* lies on the other side of the *Y* axis since it is compression and its value is negative. When the circle is drawn we find that the maximum shearing stress is on a plane at 90° which corresponds to the plane in the metal at 45°. Its value in this case is equal to the maximum normal stress. From line *B* of Fig. 8 we notice in this case that the yield point or critical shearing strength is reached first and that a great amount of elongation takes place before the corresponding normal stress is brought up to the ultimate strength or critical normal stress of the metal at which time failure occurs.

Now consider the case of a metal subjected to tension in two directions at right angles, in Fig. 10. This represents some of our so-called brittle failures which have occurred in welded ships. Point *A* in Mohr's circle of stress represents the tensile stress at zero angle, and point *B* represents the other tensile stress. It is seen that the resulting circle drawn is extremely small; in fact, if the two tensile stresses are equal, the two points *A* and *B* will coincide and there will be no circle. In other words, the all-important shearing stress resulting from the loading will be equal to zero. In this case we notice from line *C* in Fig. 8 that the tensile stress or normal stress will build right up as the load is applied until it reaches the ultimate strength or critical normal stress, at which time fracture will occur. Since the

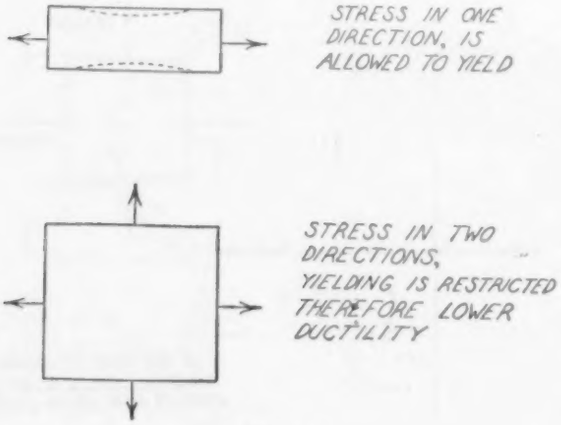

STRESS IN ONE DIRECTION, IS ALLOWED TO YIELD
STRESS IN TWO DIRECTIONS, YIELDING IS RESTRICTED THEREFORE LOWER DUCTILITY

Fig. 11

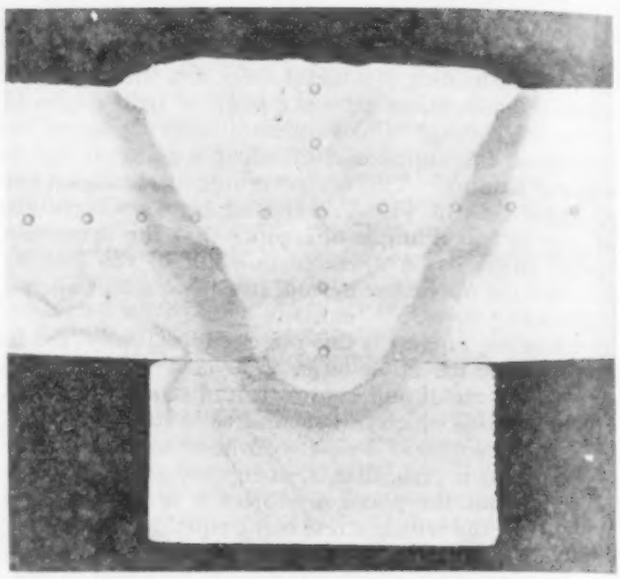


Fig. 12—E6010 Weld. × 2

critical shearing stress was not reached first, the metal will fracture with very little elongation. In fact the only elongation that is obtained is due to the elastic stretch of the metal while within the elastic limit.

We have seen that each metal has a definite maximum value for the normal stress and the shearing stress for which it can withstand, and if the loading is such that this maximum normal stress is exceeded first, then failure occurs without any plastic deformation and we say that the metal is brittle. If, however, the loading is such that the maximum shearing stress is exceeded first, then plastic deformation takes place until the maximum normal stress is finally reached, at which time the metal fails and we say that the metal is ductile.

This is important because metals which show good ductility under a simple tensile test often behave as a brittle material when subject to biaxial and triaxial stresses, or stresses in more than one direction. Because of this type of loading very little flow can take place. In a simple tensile test, the specimen is allowed to neck down and thus undergo plastic flow before failure and there is sufficient flow to call the material ductile, see Fig. 11. However, if the necking down is restricted by an additional tensile stress at right angles to the first stress, then failure will occur at the same value as before but will occur before any appreciable elongation has taken place. Locked-up stresses are reduced by the metal yielding or elongating in the direction of the stress. Most failures are caused by the material being too restrained, and as a result, the loading stress is allowed to build up suddenly above the breaking point without any yielding of the material.

Perhaps there is some thought that this slightly lower value of elongation of the E6012 electrode might indicate weld metal of lower quality, but this is not the case. This difference in elongation as compared to that of E6010 electrode is simply due to a slightly faster rate of cooling. We know that the greater portion of heat in a welding arc using coated electrodes is developed at the negative side. For this reason we use reversed polarity with E6010 electrodes. Since the electrode is positive and the base plate is negative, the base plate will receive a greater portion of heat than if using straight polarity. In this case the base plate will heat up more, resulting in greater penetration. We do not get a high deposition rate because of the lower heat on the elec-

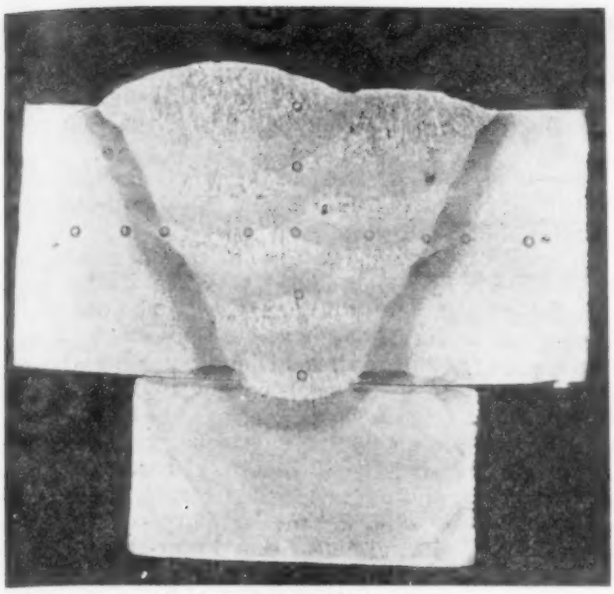


Fig. 13—E6012 Weld. × 2

trode, and if straight polarity were used on this electrode it would be more heat than the electrode could stand and it would spatter and roar. This is one reason why this electrode cannot be used on alternating current since every half cycle the current would be straight polarity. Because the base plate receives more heat the penetration will be deeper and the weld will cool more slowly, resulting in a higher elongation and lower yield point and tensile strength. On the other hand, straight polarity is used for E6012 electrodes. Here the electrode is negative and the base plate is positive. In this case the electrode receives more heat, resulting in a very high deposition rate, while the base plate will receive less heat, causing less penetration and a faster rate of cooling so that the weld metal will have lower elongation and higher yield point and tensile strength. This can be shown in Fig. 12 which is a photomacrograph of a E6010 weld and Fig. 13, a E6012 weld. These are at 2 power. In comparing the two it is noticed that the darker heat-affected area is much larger and extends further into the base metal in the case of the E6010 weld than it does in the E6012 weld. Since this heat-affected area is base metal which has been heated up above the critical temperature, it means that this heating has extended further into the base metal in the E6010 weld, and therefore since more heat has been put in, the rate of cooling of the weld metal will be slower.

Figure 14 is a photomicrograph of the junction of weld metal, at 100 power. This is of E6012 weld metal, and shows the metal to be uniform and free from inclusions. Hardness values were taken across the specimens and are plotted in Fig. 15. These are Rockwell B. There is a very definite increase in hardness in the case of the E6012 electrode, indicating a faster rate of cooling. Most manufacturers of welding electrode agree that the chemical analysis of weld metal produced by these two types of electrodes is identical. The core wire is the same; the only difference in the two electrodes is their coating, and we know in this case, that the coating serves only to afford a sufficient gas shield for the arc and proper slag coverage of the weld. The analysis of weld metal in the two specimens used was found to be:

	E6010 Weld Metal	E6012 Weld Metal
Carbon	0.06	0.06
Manganese	0.40	0.40
Silicon	0.10	0.14
Sulphur	0.027	0.026
Phosphorus	0.018	0.021
Copper	0.03	0.02
Nickel	0.06	0.08
Chromium	0.02	0.01
Molybdenum	0.02	0.03

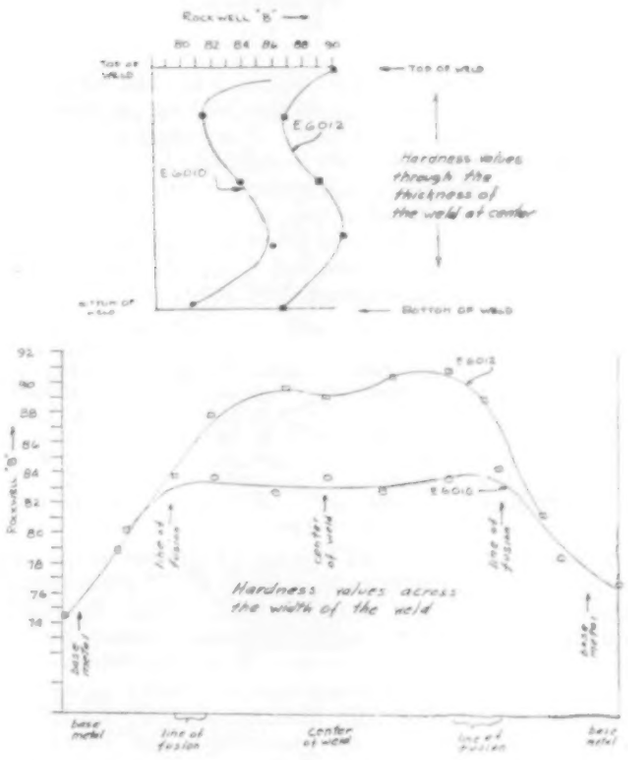


Fig. 15

Weld Metal Base Metal

Fig. 14—Junction of Weld Metal and Base Metal. 100 ×

We know that for any carbon steel, the elongation is inverse to the tensile-strength, although this may not be a straight-line relationship. The higher the tensile strength, the lower will be the elongation and vice versa.

The faster the rate of cooling, the higher will be the tensile strength and the lower the elongation; the slower the rate of cooling, the lower will be the tensile strength and the higher the elongation. To further show this effect of cooling rate upon the elongation of weld metal, standard 0.505-in. diameter all-weld-metal specimens were made using E6010 and E6012 electrodes.

Three sets of four specimens of both electrodes were made and pulled, and the yield point, tensile strength and elongation in 2 in. were taken. The first set was pulled in the as-welded condition, the second was an-

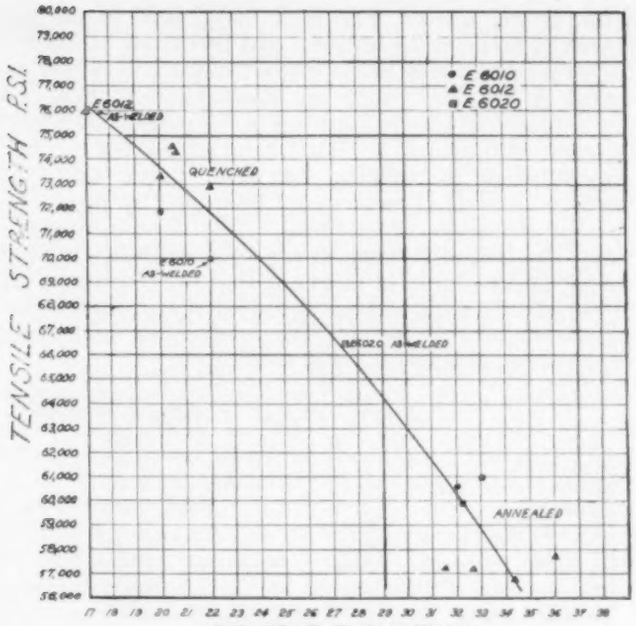


Fig. 16

nealed by heating to 1650° F. for 1 hr. and allowed to cool slowly in the furnace, and the third set was quenched from 1650° F. into an oil bath. The purpose of this was to show that the E6012 electrode could have as high an elongation as the E6010 electrode if it had the same rate of cooling, and likewise the so-called good ductility E6010 electrode could have lower elongation equivalent to E6012 if its rate of cooling were as fast. The average values of each four specimens are as follows:

	Yield Point	Tensile Strength	Elongation in 2 In., %
E6012 as-welded	61,000	78,000	17.0
E6010 as-welded	59,050	70,250	21.2
E6012 annealed	39,475	57,200	33.8
E6010 annealed	43,300	60,500	33.6
E6012 quenched	57,600	73,850	20.8
E6010 quenched	54,750	70,570	19.1

It is seen here that the average elongation in the case of the quenched E6012 weld metal is 20.8% while that of quenched E6010 weld metal is 19.1%. Here the E6012 actually has a slightly higher elongation when the two are cooled at the same fast rate. When the two were annealed under the same conditions they have almost the same elongation, 33.8% for E6012, and 33.6% for E6010. When all of these values are plotted as in Fig. 16, a curve may be passed through these clusters of points to show the relationship between tensile strength and elongation, we find that the higher tensile strength is associated with lower elongation and faster cooling rate. Some of the specimens broke near one end and therefore elongations may be somewhat lower since a portion of it occurred outside of the 2-in. gage points. This might account for some of the values not lying on the curve; nevertheless, they are close enough to show this relationship between tensile strength and elongation for different rates of cooling.

As noticed in the manufacturer's literature, the elongation values of the stress-relieved E6012 weld metal do not come up to that of the stress-relieved E6010 weld metal; the reason for this is that the stressed-relieved specimens are not heated above the critical temperature and therefore the structure of the faster cooled E6012 weld metal will still be retained. It will have only undergone a tempering effect as far as its structure is concerned. It is necessary to anneal by heating above the critical temperature to produce the structure of a slowly cooled metal. When this is done the elongation values are identical for both the E6010 and the E6012 weld metals.

Figure 3 contains stress-strain curves for base metal, E6010 weld metal and E6012 weld metal in the as-welded condition.

It is said that the E6012 type of electrode in some cases has a tendency for inclusions. Weld metal when molten has the property of absorbing gases, and upon cooling, these gases separate out and rise to the surface. Because of the quick freezing of all weld metal some gas is trapped, and naturally with the faster cooling E6012 weld metal there will be a tendency for more gas to be trapped. The same can be said about slag inclusions. Some slag is always trapped in molten weld metal. This slag tends to rise to the surface, and the faster the freezing, the more slag will be trapped. For all practical purposes these inclusions are not harmful unless they lower the strength or ductility below a desired value. As far as the E6012 weld metal is concerned, the slightly lower ductility is not caused by any possible inclusions, it is a matter of cooling rate; even under adverse conditions if it should contain inclusions, it still has a tensile strength much above that of E6010 weld metal, so that there should be no argument against this electrode as far as the possibility of inclusions is concerned unless it should interfere in some other manner.

One might justly question the reason for the restriction of the E6012 type of electrode. To be sure the reason is that this type of electrode produces weld metal with slightly less ductility, 17 to 22% elongation in 2 in. with 0.505-in. all-weld-metal specimen, and in some cases there is a slight tendency for inclusions. We know that its elongation in this case is 17 to 22% but on what basis do we say that this elongation is not sufficient? Perhaps for the same reason we could say that the elongation of E6010 electrode which is 22 to 27% is not sufficient. Just how did we draw the line between these two electrodes. Perhaps it was that the E6010 electrode which was the first coated electrode to be produced just happened to have an elongation of 22 to 27% and we have become used to expecting that. Then when the E6012 electrode was developed with 17 to 22% elongation, we say that it does not come up to standards.

If this is the case then perhaps we should now restrict the use of E6010 electrodes because since it was first put on the market there have been produced several electrodes of the E6020 and E6030 class with elongations of 25 to 30%. If this 4 or 5% of elongation is so important, then we should take advantage of the E6020 and E6030

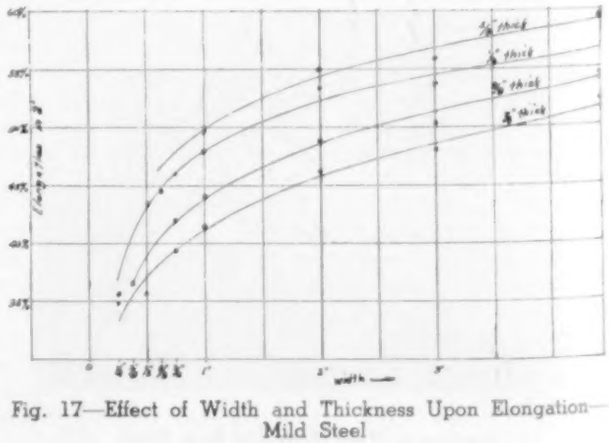


Fig. 17—Effect of Width and Thickness Upon Elongation—Mild Steel

electrodes and stop the use of E6010. Of course we will never do this because the E6010 electrode has several very definite advantages over other types, and we are satisfied that its ductility is more than sufficient, even though it is several per cent lower in elongation than the E6020 and E6030 types. The same argument should also hold in the case of the E6012 electrode, since it is only a difference of a few per cent in elongation.

When we require a minimum of 22% elongation for E6010 weld metal we are referring to a specimen having a diameter of 0.505 in. and using a gage length of 2 in. From Fig. 17 we see that the elongation values for any one particular steel depend upon its size and shape. In this case of mild steel we have elongation values from 35 to 40% for the same piece of steel. When we insist upon 22% for a 0.505-in. specimen we will have greater elongations for larger specimens and likewise lower elongations for smaller specimens. Why hold to 22% elongation for weld metal when we know that a smaller specimen of the same weld metal will have elongations below 22%? It seems then that this minimum value of 22% for elongation is not from an engineering demand, but rather a thought or belief that this elongation value will insure sound weld metal. We have shown that this slightly lower elongation of the E6012 weld metal is due to a faster cooling rate. Therefore, it seems that if sound weld metal can be assured there should be no need to further restrict this electrode.

If this E6012 electrode did not have certain advantages over the E6010 electrode there would be no reason to use it, but it has certain advantages which put it in a class by itself. Because of its particular type of coating it has a high deposition rate, and it is ideal for poor fit-up joints in that it does not undercut easily. It can handle high currents without excessive spatter. A greater portion of heat is available at the end of the electrode to melt it, while less heat enters the base plate. This helps to reduce distortion by shortening the time of welding because of the higher deposition rate and decreasing the amount of heat entering the base plate. This electrode produces a convex weld thus insuring a full size weld. It is also ideal for multipass fillet welds in that the passes do not run down as do the so-called hot rods, but rather hold their shape.

If these restrictions are justified then they should remain, but some explanation should be given. However, if these restrictions are not justified, then they should be lifted so that the welding industry could take full advantage of a good electrode which very definitely has an established and recognized place in welding.

Templet Tips

By Rudolph Chelborg*

Practical Suggestions on Making Strip Templets for Cutting Difficult Shapes

HERE ARE a few tips, suggested by operators who have used the ideas in making and using templets for oxyacetylene machine cutting of shapes involving sharp corners or other peculiarities. These ideas should suggest solutions for similar problems faced by other operators.

Save Time—Increase Accuracy

The templet strip should be formed so that the inside of the bend is against the layout line whenever possible, allowing the operator a continuous view of the layout line. This is often impossible when forming complicated shapes containing reverse bends, for example, unless a parallel line is drawn inside the original layout line at a distance equal to the thickness of the templet strip, as shown in Fig. 1.

Gated Templet for Corners

When a sharp corner is called for in the layout, it can be produced by incorporating a swinging section in the templet, as shown in Fig. 2. The usual method should be followed for determining nozzle size and kerf width, for scribing the layout line on the templet base, and for forming the templet and riveting it to the base plate. The only difference is that one section of the templet should be left out, as shown. The ends of the templet strip that are

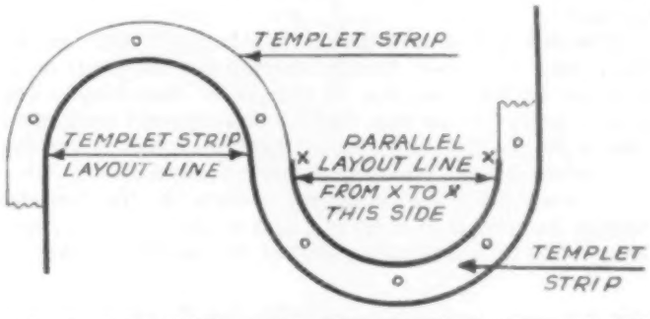


Fig. 1—A Parallel Layout Line Drawn Inside the Curve of the Original Layout Line at a Distance Equal to the Thickness of the Templet Strip Will Help the Operator to See the Layout Line at All Times While Forming the Templet

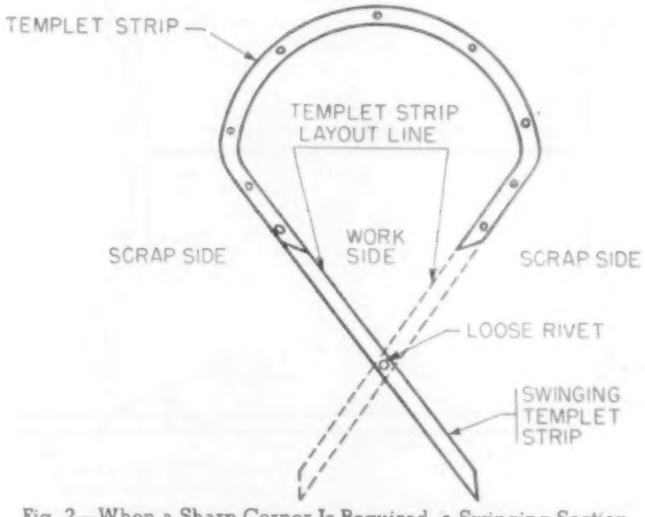


Fig. 2—When a Sharp Corner Is Required, a Swinging Section Can Be Made in the Templet so That Both Starting the Cut and Finishing It Will Take Place in the Scrap

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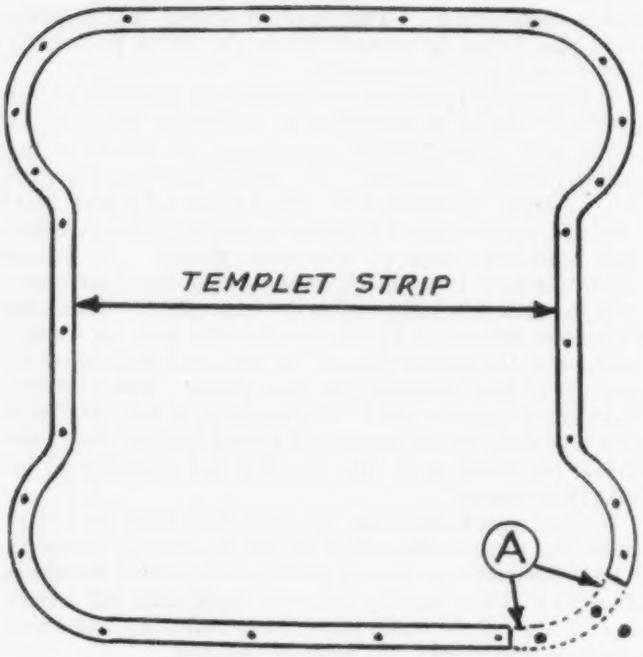

Fig. 3—The Removable Section of a Strip Templet, Held in Place on Dowel Pins Inserted in the Base, Is Indicated by the Dotted Lines at A in the Sketch

riveted to the base should be cut at an angle of 30 degrees. A straight piece of templet strip should then be fitted to the layout line, with the ends of this piece also cut at a 30-deg. angle to match the ends of the riveted section.

This straight section should be attached to the templet base with one rivet, loosely enough for the strip to be rotated without binding or danger of distortion. The center point of the hole for the rivet should be located directly outside that point in the layout line where the center lines of the two templet strips intersect.

In operation, the swinging section of the templet should be turned to meet one end of the stationary section. The templet-tracing unit of the cutting machine is placed on the swinging section outside the rivet so that the cut will start in the scrap. After the tracing unit has moved off the swinging section and onto the stationary section, the swinging section is rotated to meet the other end of the stationary section. Thus, the templet-tracing unit will move off the stationary section of the templet onto the swinging section again, completing the cut and leaving a sharp corner.

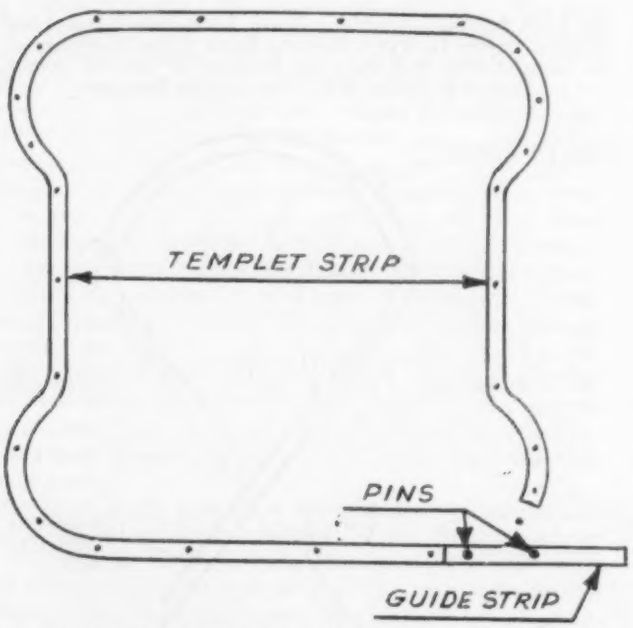

Fig. 4—The Cut Is Started at the Plate Edge, with a Straight Guide-Strip Section, Held on Dowels, Used to Lead It in to the Work

Removable Gate for Lead-Ins

The use of a removable lead-in gate section simplifies leading in to the templet cuts that must be started at the edge of the plate. The templet strip is formed and attached to the base plate in the usual manner, with the exception of a small section on a curve near the edge of the plate as, for example, that shown at A in Fig. 3. This section is then formed and held in place on dowel pins inserted in the templet base so that it can be lifted off. A straight guide-strip section is prepared and is held in place by two pins, as shown in Fig. 4. One of these pins is also used for holding the curved section of the templet; the other is located outside the position of the curved section.

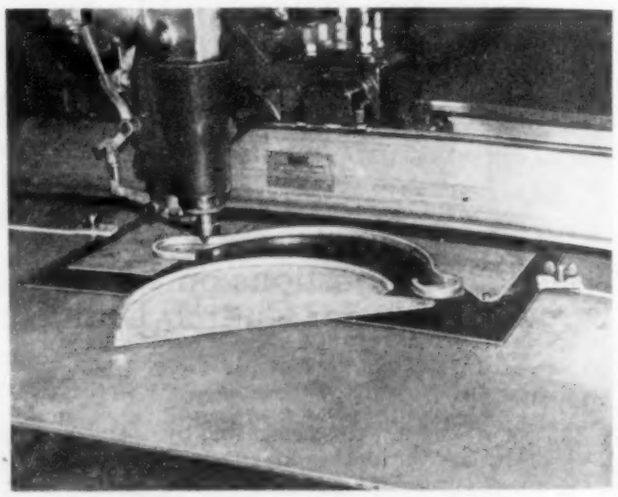

Fig. 5—Either Side of This Templet for a Narrow Shape Can Be Swung Out of the Way to Provide Clearance for the Tracing Unit

In using this templet, the cut is started at the plate edge, with the tracing unit on the straight section. When the tracing unit has progressed to the stationary part of the templet, the straight section is lifted off the dowel pins and the curved section is put in place to complete the cut.

Sectional Templets

Another example of ingenuity in making strip templets under difficult circumstances is the sectional templet shown in Fig. 5. The part to be shape-cut is so narrow that the templet-tracing unit would not have sufficient clearance between the two sides of a templet made in the usual way. To overcome this, the templet is made in four sections. The two rounded end sections are riveted securely to the base, while the two side sections are riveted to pieces of light-gage steel, trimmed where necessary to conform to the shape of the templet. These pieces are attached to the base plate by a pivot at one end. Thus, it is possible for one side section to be swung

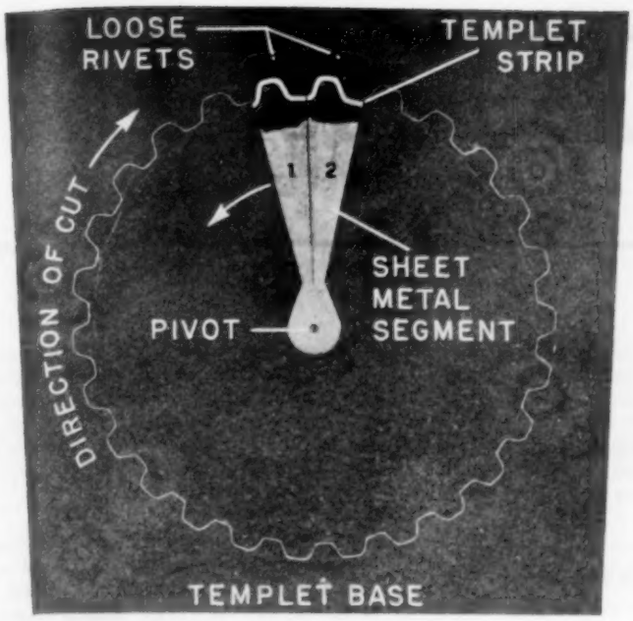

Fig. 6—This Templet for Cutting Sprockets Has Two Sheet-Metal Segments, Each of Which Has Attached to It a Templet Strip Conforming to One Section of the Sprocket Design

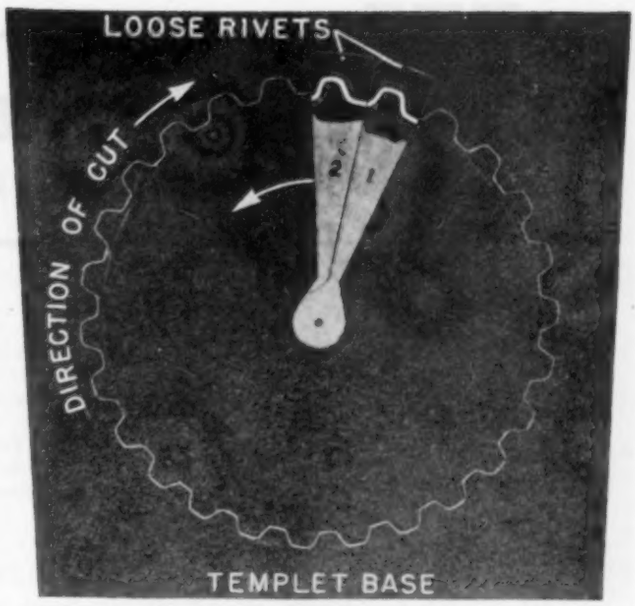

Fig. 7—One Segment After the Other Is Rotated to Its Position Ahead of the Cutting Action and Is Held in Place by a Loose Rivet Inserted in a Hole in the Templet Base

out of the way while the tracing unit is following the other side section.

Segmented Sprocket Templets

The templet for cutting sprockets, illustrated in Fig. 6, consists of a base plate and two sheet-metal segments that can rotate around a pivot point located at the exact center of the layout. To each sheet-metal segment is attached a formed templet strip that conforms to one section of the sprocket design. Very careful and exact workmanship is required in the construction of a templet of this sort so that the sprocket teeth will all be correctly shaped and the spacing between the teeth will be uniform over the entire circumference.

In operation, the two segments are placed side by side as shown in Fig. 6, and are held in place by loose rivets or pins inserted in holes made for this purpose. The cut is started with the tracing unit operating on the templet strip attached to segment No. 1. After the cut has progressed so that the tracing unit is operating on the templet strip on segment No. 2, the loose rivet is removed from segment No. 1 and the segment is swung around the pivot point to the position shown in Fig. 7. The rivet is inserted through the hole in this position. As the cut progresses, one segment after the other is rotated to a new position ahead of the cutting action and, while guiding the tracing unit, is held in place by means of the loose rivet or pin inserted in a previously made hole.

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(*Continued from page 639*)

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THE AMERICAN WELDING SOCIETY

ACTIVITIES – RELATED EVENTS

TWENTY-SIXTH ANNUAL MEETING

Upon recommendation of the Convention Committee, the Board of Directors at its meeting on June 28th approved plans for holding a convention-by-mail and confining the necessary business meeting, award of medals and Directors' meeting to a one-day affair.

In compliance with ODT requirements, the meeting will be arranged so as not to require the presence of more than fifty out-of-town members.

It will be necessary to dispense with the Section Officers Conference, Committee and Research Meetings. Individual Committees may hold meetings at other times and places as may be found necessary to aid in the war effort.

The schedule for the one-day meeting will be as follows:

Thursday, October 18

9:30 A.M. to 10:30 A.M.—Award of prizes, medals and honorary memberships.

10:30 A.M. to 12 noon.—Presentation of Adams Lecture by Dr. S. L. Hoyt.

Luncheon.—Facilities will be provided for a luncheon. Details will be announced later.

2:00 P.M. to 3:00 P.M.—Annual Business Meeting of A.W.S.

3:00 P.M. to 5:00 P.M.—Meeting of new Board of Directors.

Evening.—Details will be announced later of a possible dinner commemorating the 25th anniversary of the founding of the New York Section of the AMERICAN WELDING SOCIETY.

In conducting the plan of a convention-by-mail, the following procedure is contemplated. In the August issue of the JOURNAL a complete list of papers authorized as Annual Meeting papers will be published. Starting with this issue and continuing for the next six months Annual Meeting papers will be published as rapidly as possible. Discussion will be invited, although it will be necessary to set a time limit for receipt of such discussion. This time limit will in each case be the 10th of the month following the issue in which the paper was published. Thus, papers published in the August issue will be open for discussion until September 10th. This discussion will then be published in the October issue, together with the author's closure.

Some sixty papers have been scheduled for presentation at the Annual Meeting. They are comparable in every way to the usual Annual Meeting papers. These papers will be eligible for consideration in the award of prizes in the same manner as if they were orally presented at regular Annual Meeting sessions. Local Sections of the A. W. S. will be urged to get in touch with the individual authors in order that these papers may become available for oral presentation at local Section meetings.

BY-LAW REVISIONS

Letter ballot on revised edition of the By-Laws, as it appears in the February WELDING JOURNAL, and supplemental Amendments, was mailed to the entire membership from headquarters under date of June 1st. If there are any members who have not received this ballot, duplicate will be sent upon request.

BOARD OF DIRECTORS MEETING

The meeting of the Board of Directors of the AMERICAN WELDING SOCIETY, held on April 19, 1945, in Room 1101, Engineering Societies Bldg., New York, was called to order by President Weigel at 10:20 A.M., with the following present:

Members: C. A. Adams, D. Arnott, H. C. Boardman, R. W. Clark, J. H. Critchett, E. V. David, J. H. Deppeler, W. F. Hess, H. O. Hill, H. W. Lawson, J. F. Lincoln, F. E. McAtee, H. W. Pierce, H. M. Priest. A.W.S. Staff: W. Spraragen, S. A. Greenberg, M. M. Kelly.

Death Announcements

The President called attention to the sudden death of Mr. G. T. Horton, President of the Chicago Bridge & Iron Co., and Past-President of A.W.S., on March 19, 1945; and also to the sudden death of Professor A. V. deForest, Chairman of Board, Magnaflux Corp., and a member of several of our Research Committees.

Upon recommendation of the President, the following committees were appointed to prepare resolutions to be spread on the minutes of a future meeting of the Board, and copies of which will be transmitted to the families of the deceased and the companies with which they were affiliated.

G. T. Horton Resolutions Committee: C. A. Adams, D. S. Jacobus, K. L. Hansen.

A. V. deForest Resolutions Committee: A. B. Kinzel, C. W. McGregor, C. E. Jackson.

On recommendation of the President, Mr. J. B. Tinnon, Vice-President of Metal & Thermit Corp., was named to fill the vacancy occurring in the Committee on Permanent Funds through the death of Mr. Horton, his term to commence as of this date and expiring October 1946. Because of seniority in respect to service, it was understood that Mr. Harter would serve as chairman in place of Mr. Horton, commencing next October, and he would also serve as chairman of the committee for the following year, fulfilling his own position in the schedule.

1946 Adams Lecturer

In accordance with prescribed rules for the Adams Lecture, a written ballot was taken on the 1945 Committee on Awards' selection of the 1946 Adams Lecture nominees, which resulted in the selection of Wendell F. Hess, Associate Professor in Metallurgical Engineering, Rensselaer Polytechnic Institute, as first choice.

Amendments of By-Laws Dated December 15, 1944

Revisions referred to in Exhibit D, accompanying agenda of this meeting, were duly considered. It was explained that submittal to the voting membership, of the revised edition of the By-Laws approved at the December 15, 1944, Board of Directors meeting, was delayed awaiting approval by the Board of Directors of these further revisions, in order to avoid expense of sending out another ballot to the voting membership.

Upon motion, duly seconded, it was voted to approve revisions proposed at this meeting to the By-Laws approved at the December 15, 1944, Board of Directors meeting.

As a measure of economy, it was stated that the membership will be asked to cast a ballot on amended By-Laws published in the February WELDING JOURNAL or the 1945 Year Book, with the additional amendments as approved at this meeting.

It was stated also that the By-Laws Committee, in due course, will give consideration to late comments received from Sections and Districts of the Society.

Future Plans of Educational Committee

Prof. Hess recalled, at a previous meeting of the Board, the Educational Committee told of its plans for making a further study of textbooks now being used in engineering colleges and schools, with a view to determining the adequacy of welding coverage, and for addressing a letter, signed by the President of the SOCIETY, to the deans of engineering schools on the subject of the place of welding in engineering education.

He reported further that more than fifty replies had been received from the Engineering School Deans. In some instances, specific information was sought. Suitable replies are being prepared by the Educational Committee members, and these letters will be sent out over the President's signature.

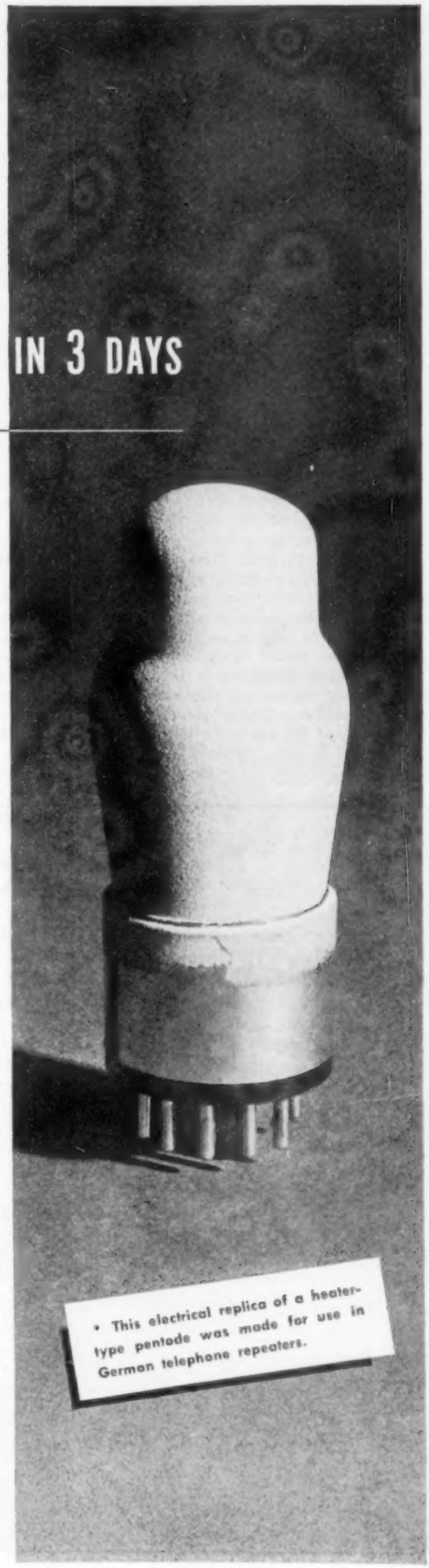
DUPLICATING A GERMAN VACUUM TUBE IN 3 DAYS

Just behind the battlefront, a telephone system lay dead. The retreating enemy, hoping to return, had not blown it up, but had taken with them its vacuum tubes. To put it back to work, the General ordered 1000 new tubes — spot delivery.

A sample tube was flown back to the United States and brought to Bell Telephone Laboratories. It was of German design, different from any American tube in both dimensions and characteristics. Could it be duplicated soon? The job looked feasible. Within three days, try-out models were on their way to Europe. Three weeks later, Western Electric Company had made and delivered every tube. They were plugged in; vital communications sprang to life.

Vacuum tubes are an old story for Bell Laboratories scientists. Back in 1912 they made the first effective high vacuum tube. Three years later, they demonstrated the practical possibilities of tubes by making the first radio talk across the Atlantic, pointing the way to radio broadcasting. Since then, they have developed and utilized the vacuum tube wherever it promises better telephone communication — there are more than a million in your Bell Telephone System.

Today, Bell Telephone Laboratories is solving many of the toughest tube problems faced by the Armed Forces. When the war is over, it goes back to its regular job—keeping American telephone service the best in the world.



• This electrical replica of a heater-type pentode was made for use in German telephone repeaters.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for our Armed Forces at war, and for continued improvements and economies in telephone service.

Because of the strong desire on the part of some engineering school professors for instructional material, such as motion picture films, stereopticon slides and informational bulletins depicting various welding operations of interest to engineering students, Prof. Hess said the committee plans to ascertain from the leading welding manufacturers and government departments how much of that kind of material is available for instructional purposes and whether, upon request, the manufacturers and government departments will be willing to loan available films and slides and donate informational bulletins to the engineering schools. Upon receipt of this information, the committee plans to prepare and issue to engineering schools, a leaflet telling what instructional material is available and how to obtain it. Before proceeding, Prof. Hess stated his committee desires the Directors' endorsement of plans outlined.

Plans for 1945 Annual Meeting

Mr. David, chairman of the Convention Committee, stated that our SOCIETY is proceeding along lines similar to A.S.M., in that our Program Committee has started work on a technical program of the same order as the past few years, with the idea that if conditions permit, a $3^1/_2$-day meeting will be held in conjunction with the National Metal Exposition. Otherwise, the papers scheduled on the program, with written discussions thereon, will be published and distributed by mail. Action on the type of meeting to be held this year is being postponed for another few months, awaiting war developments.

REPORT ON READERS' INTEREST IN *THE WELDING JOURNAL*

The A.W.S. Publication Committee is charged with the general supervision of the publication of THE WELDING JOURNAL. Suggestions are made occasionally by well-meaning groups, that the JOURNAL should be altered to place more emphasis on this or that type of article. The Publication Committee felt that any steps taken by it should be based on facts. Accordingly, a questionnaire was prepared to be sent to the membership of the SOCIETY. The questionnaire was prepared in such detail that each reply provided for exactly 50 possible votes.

In order to keep the analysis to manageable proportions, the Editor eliminated some 2000 JOURNAL subscribers and only sent the questionnaire to the 6500 members who had paid their dues by November 15th. This number represents about two-thirds of the circulation of the JOURNAL. The balloting was closed December 30th when a total of 1627 replies had been received or 25% of the possible replies. Experiences with other questionnaires have indicated that the deviation from results obtained by such sampling will not vary more than 1 or 2% from totals which will be obtained when all the replies are in. Even at that, this represents an analysis of some 81,000 possible different votes.

The 1627 replies are broken down in the following groups:

Operators	156
Foremen, Inspectors and Instructors	431
Designing Engineers and Draftsmen	213
Technical, Metallurgical, Research	337
Sales and Advertising	215
Purchasing, Administrative	275
Total	1627

In order to make the analysis comparable, each group's replies were calculated on a percentage basis. A detailed analysis of replies to each question on the questionnaire is given for each group and the total which, of course, is the average. Not all the questions were answered so that in many cases the sum total of the percentage for any question does not equal 100%.

As a result of this analysis the Publication Committee felt that the widespread readers' interest among all groups indicated, that no drastic revision should be made in the setup of THE WELDING JOURNAL.

December 31, 1944

All Figures on a Percentage Basis
Total copies sent 6500. Received 1627

Interest in Sections of Journal

	Much	Moderately	Little
Advertising			
Total	21	57	15

INDEX TO ADVERTISERS

Air Reduction Sales Co. . . . . Outside back cover
American Brass Company 685
American Chain & Cable Company, Inc. 677
American Optical Co. 669
Anti-Borax Compound Company 682
Arcos Corp. . . . . Inside front cover

Bastian-Blessing Co. 668
Bell Telephone System 661

Champion Rivet Company 697
Chicago Steel & Wire Co. 678

Eisler Engineering Co. 680
Electroloy Co., Inc. 684
Eutectic Welding Alloys Company . . . . . 688 & 689

Federal Machine & Welder Co. . . . . 672 & 673

General Electric Co. . . . . Insert 706 & 707

Haynes Stellite Company 640
Hobart Brothers Co. 625

International Nickel Co. 687

Chas. W. Krieg Co. 670

The Lincoln Electric Co. . . . . 690 & 691
The Linde Air Products Company 627

P. R. Mallory & Co., Inc. 693
The McKay Company 701
Metal & Thermit Corporation 695
The Midland Paint & Varnish Co. 670

National Carbide Corporation 674
National Time & Signal Corp. 708
Nelson Specialty Welding Equipment Corp. . . 671
New Mexico Steel Company 678

Oakite Products, Inc. 676

Page Steel & Wire Division 677
The Reid-Avery Company 665

Resistance Welder Mfrs. Association 705

Sciaky Bros. 681
Shawinigan Products Corp. 680
The Sight Feed Generator Company 666
A. O. Smith Corporation 667
Standard Machinery Company 664

The Taylor-Winfield Corp. 701
Tube Turns, Inc. 663

Una Welding, Inc. 699
Union Carbide and Carbon Corp. . . . . 627 & 640
United Welding Company 676

Victor Equipment Co. 628

Westinghouse Elec. & Mfg. Co. . . . . Inside back cover, 675 & 683

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TUBE-TURN WELDING FITTINGS—RANGE OF SIZES

Type of Fitting	Description	Standard Weight	Extra Strong	Schedule 160	Double Extra Strong	Light Gauge	
						Nominal Pipe Size	Iron Pipe Size
Elbows	90° Long Radius	½"-24"	¾"-24"	1"-12"	1"-8"	4"-24"	3"-12"
Elbows	90° Short Radius	1"-30"	1½"-30"				
Elbows	45° Long Radius	½"-30"*	¾"-30"*	1"-12"	1"-8"	4"-24"	3"-12"
Returns	180° Long Radius	½"-24"	1"-24"	1"-12"	3"-8"	4"-24"	3"-12"
Returns	180° Short Radius	1"-30"	1½"-30"				
Returns	180° Extra Long Radius	1"-2½"	1"-2½"				
Tees	Straight	¾"-24"	¾"-24"	1"-12"	1"-8"		
Tees	Reducing Outlet	¾"-24"	¾"-24"	¾"-12"	1"-8"		
Reducers	Concentric & Eccentric	1x⅜-24x20	1x⅜-24x20		1x⅜-12x10		
Caps		1"-24"	1"-24"		1"-8"		
Stub Ends	Lap Joint	1"-24"	1"-24"				
Nipples	Shaped, 90° to Header	1¼"-12"	1¼"-12"				
Nipples	Shaped, 45° to Header	1¼"-12"	1¼"-12"				
Saddles		2"-24"**					
Laterals	Straight	1¼"-24"	1¼"-24"				
Laterals	Reducing-on-Run	1¼"-24"	1¼"-24"				
Crosses	Straight	¾"-24"	¾"-24"				
Rings	Welding	¾"-12"	¾"-12"				
Sleeves	Welding	2"-24"**					

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*30° size short radius.

**Since saddles and sleeves are used for external reinforcement only, they do not conform to iron pipe size thicknesses.

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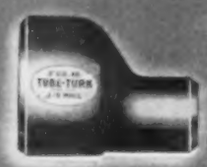
Welding Neck	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Slip-On	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Lap Joint	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Threaded	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Blind	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Socket Type	¼"-24"	¼"- 4"		¼"-3½"			
Reducing-threaded or slip-on	¾"-24"	¾"-24"	¾"-24"†	¾"-24"	¾"-24"*	¾"-24"	¾"-12"
Orifice—threaded		1"-24"	4"-12"	4"-12"	3"-12"	1"-12"	
Orifice—slip-on		1"-24"					
Orifice—welding neck		1"-24"	4"-12"	1"-12"	3"-12"	1"-12"	
Long Welding Neck	1"-24"	1"-24"	1"-10"	1"-10"	1"-10"	1"-10"	

†Dimensions on sizes thru 3½" same as for 600 lb. flanges.
*Dimensions on sizes thru 2½" same as for 1500 lb. flanges.

CONCENTRIC REDUCER



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Operator	20	58	10
Foremen, etc.	18	57	17
Designing Engr.	11	64	21
Tech. & Res.	13	60	20
Sales & Adv.	40	51	4
Purch. & Admin.	29	51	16
Engineering & Technical			
Total	88	10	1
Operator	83	14	2
Foremen, etc.	86	10	1
Designing Engr.	95	5	0
Tech. & Res.	94	5	1
Sales & Adv.	84	14	1
Purch. & Admin.	85	14	1
News Items & Society			
Total	23	54	18
Operator	33	46	15
Foremen, etc.	27	50	16
Designing Engr.	14	63	21
Tech. & Res.	14	63	16
Sales & Adv.	34	45	16
Purch. & Admin.	21	52	26
Research Supplement			
Total	60	30	6
Operator	64	24	8
Foremen, etc.	64	26	4
Designing Engr.	60	36	4
Tech. & Res.	81	15	2
Sales & Adv.	36	42	15
Purch. & Admin.	46	44	7

Sections to Be Given More Space

	Adv.	Engng.	News	Re-search	As Is
Total	2	44	3	14	37
Operator	2	46	2	20	40
Foremen, etc.	1	48	4	15	32
Designing Engr.	0	47	2	8	42
Tech. & Res.	1	39	1	22	37
Sales & Adv.	2	45	6	9	38
Purch. & Admin.	3	40	4	7	46

Degrees of Interest in Articles

	Much	Moderate	Little
A. Research			
Total	57	35	6
Operator	59	33	6
Foremen, etc.	64	30	4
Designing Engr.	51	42	6
Tech. & Res.	79	19	2
Sales & Adv.	38	46	14
Purch. & Admin.	39	49	10
B. Operating Techniques			
Total	73	23	3
Operator	88	10	2
Foremen, etc.	80	17	2
Designing Engr.	63	30	6
Tech. & Res.	60	36	4
Sales & Adv.	75	21	2
Purch. & Admin.	77	20	3
C. Telling How			
Total	53	32	13
Operator	88	8	3
Foremen, etc.	64	26	8
Designing Engr.	41	42	15
Tech. & Res.	28	45	25
Sales & Adv.	55	33	11
Purch. & Admin.	54	31	12
D. What Other People are Doing			
Total	53	39	7
Operator	65	33	2
Foremen, etc.	60	34	5
Designing Engr.	42	46	9
Tech. & Res.	36	52	11
Sales & Adv.	66	29	4
Purch. & Admin.	5	39	6
E. Designing, Planning & Testing			
Total	64	30	5
Operator	71	24	4
Foremen, etc.	73	23	3
Designing Engr.	82	15	2
Tech. & Res.	52	41	6
Sales & Adv.	46	43	10
Purch. & Admin.	62	31	6
F. Codes & Standards			
Total	53	37	8
Operator	49	36	10
Foremen	58	35	7
Designing Engr.	57	35	7
Tech. & Res.	56	36	7
Sales & Adv.	40	48	9
Purch. & Admin.	52	38	9

Section Activities

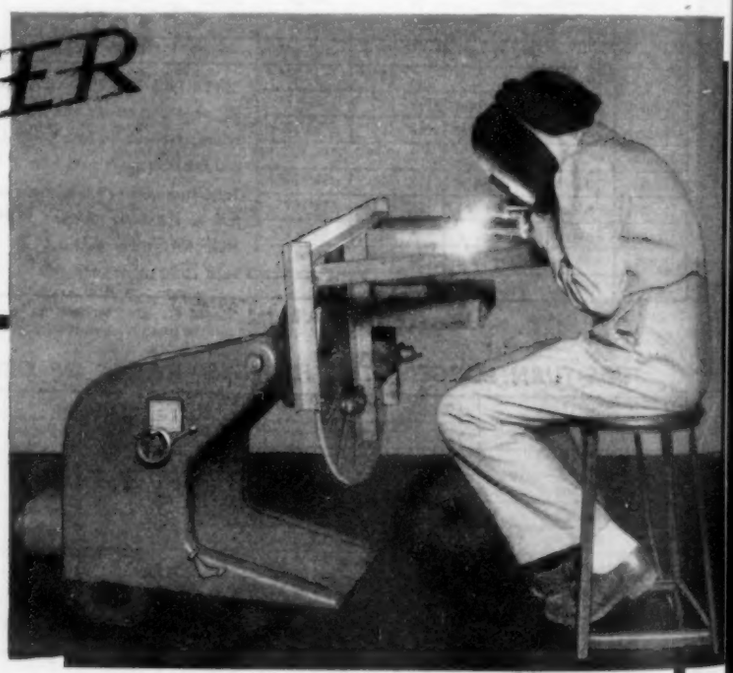
Read	Frequently	Occasionally	Seldom	Curtail	As Is	Amplify
Total	34	50	16	14	77	8
Operator	38	53	7	8	79	13
Foremen	42	47	11	8	84	7
Designing Engr.	29	50	20	16	80	4
Tech. & Res.	28	53	18	16	78	5
Sales & Adv.	40	48	9	23	65	10
Purch. & Admin.	25	50	24	16	74	9

Current Welding Applications

Section Should Be	Curtailed	As Is	Amplify
Total	3	62	35
Operator	2	49	47
Foremen	2	58	40
Designing Engr.	2	68	30
Tech. & Res.	2	74	24
Sales & Adv.	8	57	35
Purch. & Admin.	1	58	40

Personalities	Continue As Is	Omit
Total	86	14
Operator	88	12
Foremen	87	13

Easier - FASTER PRODUCTION WELDING WITH "Standard" WELDING POSITIONER



- Completely powered; easy, instant control.
- Rotation of table, either direction, 0" to 180" per min.
- Height of table adjustable from 30" to 36".
- Table hydraulically power tilted 135° from horizontal and 150° through full range.
- Capacity for work up to 700 lbs.

WRITE FOR CATALOG

STANDARD MACHINERY CO.

1471 Elmwood Ave., Providence 7, R. I.

RACO 8 ELECTRODES

FOR SOUND WELDS WITH POOR FIT-UPS

Whenever you have to bridge wide gaps, that is the time to use RACO 8 Electrodes. These electrodes are heavily coated; can be used in any position . . . direct current, straight polarity or alternating current.

RACO 8 Electrodes meet the requirements of these specifications:

A.W.S.—A.S.T.M. Specification A233-43T, Type E-6012

A.S.M.E. Boiler Code, paragraph U-70

American Bureau of Shipping, Grade H1G and B2G (A.C. or D.C.)

RACO 13

Electrodes likewise give splendid results when welding on light and medium gauges of mild steel. These electrodes comply with A.W.S.—A.S.T.M. Specifications A233-43T, Type E-6013.

★

Send for samples, try out RACO 8 and 13 Electrodes and be convinced of their superior qualities.

The REID-AVERY COMPANY

INCORPORATED

DUNDALK • BALTIMORE 22 • MARYLAND

SINCE 1919 PRODUCERS OF ARC WELDING ELECTRODES AND WELDING RODS

Designing Engr.	80	20
Tech. & Res.	88	12
Sales & Adv.	88	12
Purch. & Admin.	86	14

What Happens to Journal

	Throw Away	File	Pass On
Total	3	62	35
Operator	0	81	19
Foremen, etc.	1	67	32
Designing Engr.	9	55	36
Tech. & Res.	2	63	34
Sales & Adv.	2	68	30
Purch. & Admin.	3	43	54

Additional readers, 2452, or average of $2^1/_2$ readers for every printed copy.

Analysis

Results of Questionnaire on Reader Interest Welding Journal

Advertising

1. Approximately 78% of the readers are interested in the advertising pages of THE WELDING JOURNAL. Ten thousand circulation × $2^1/_2$ readers per issue × 78% = 19,500 readers of advertising.

2. The deviations from the averages in individual groups is understandable and requires no special comment.

3. Two per cent of the readers would like to see the advertising increased.

Engineering and Technical Articles

1. Approximately 98% of the readers of the JOURNAL are interested in this section.

2. The deviation of general interest of groups from the average for this section is not significant.

3. Forty-four per cent of our readers would like to see the space devoted to this section increased.

4. The greatest average interest in this section is for those articles dealing with operating techniques and least for those dealing with how to do a particular kind of job. Articles dealing with designing, planning and testing also rate very high in average reader interest. Surprisingly enough, the average interest for articles on research and codes and standards is materially lessened when compared with the results of previous years, although 90% of the readers are either much or moderately interested in these articles.

5. There is wide variation of interest among the different groups in the different types of technical articles. The operator, foreman and supervisor is more interested in research articles than is the designing engineer or draftsman. About twice as many operators (percentages) are interested in these articles as compared with the sales engineer, purchaser or executive. Again, practically everybody is interested in operating techniques. On the expected side is the interest of the operator in articles "telling how." There is also large expected wide interest in articles dealing with designing, planning and testing.

6. A little over half (53%) of the membership are intensely interested in codes and standards, and an additional 37% are moderately interested in this section.

News Items, Society & Related Activities

1. In its entirety this section has the least appeal to our membership, even less than advertising and yet 3% of the membership wanted this section increased.

2. In the breakdown we begin to see some of the reasons. There are quite a few people (14%) who would like to see the portion devoted to "Section Activities" curtailed and the Personalities omitted (14%). In some measure this is offset by others (8%) who would like to see "Section Activities" enlarged.

3. Fully 97% of the membership would like to see the news part "as is" or amplified.

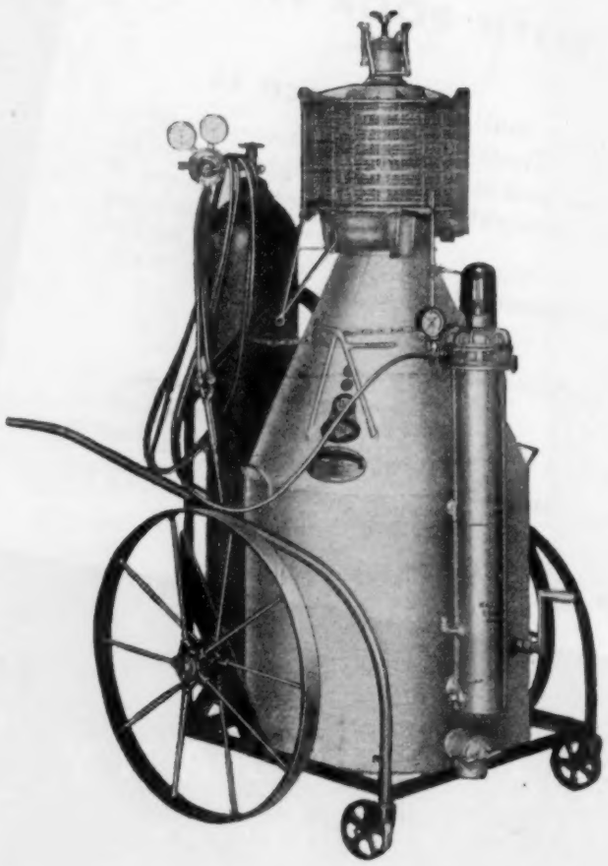
Research Supplement

1. Ninety per cent of our readers are much or moderately interested in the Supplement. Six per cent admit they have little or no interest and surprisingly enough this lack of interest is greatest in the sales and advertising group.

2. Fourteen per cent of our readers would like to see this section amplified and curiously enough 20% of the operators voted for such an increase.

What Happens to Journal

1. Three per cent of our readers throw their JOURNALS away. Another 35% pass them on to others, but the greater part of these have indicated on the questionnaire that they get them back and file them.



Let's suppose you could *make your own* GASOLINE, FOR 5¢ TO 10¢ PER GALLON!

● If you could manufacture an unlimited supply of high-test gasoline for your own use, at about a nickel a gallon, you'd buy the equipment to do so mighty soon—particularly if that equipment proved to be reasonably priced and easy to operate.

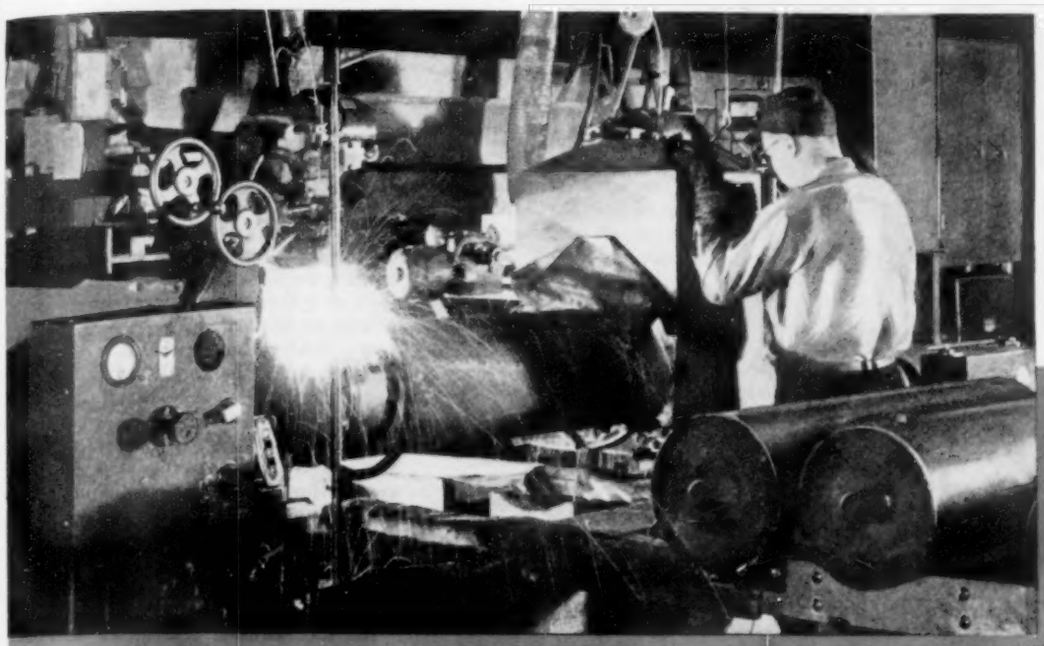
We don't know where you can buy a machine of this type. However, you *CAN* buy a SIGHT FEED generator to make your own acetylene, and save 50% to 75% of the money which you are now paying for "bottled" acetylene.

Think it over, and then contact your jobber or drop us a line and request a SIGHT FEED catalogue. You'll be glad you did!

ACETYLENE Sight Feed GENERATORS

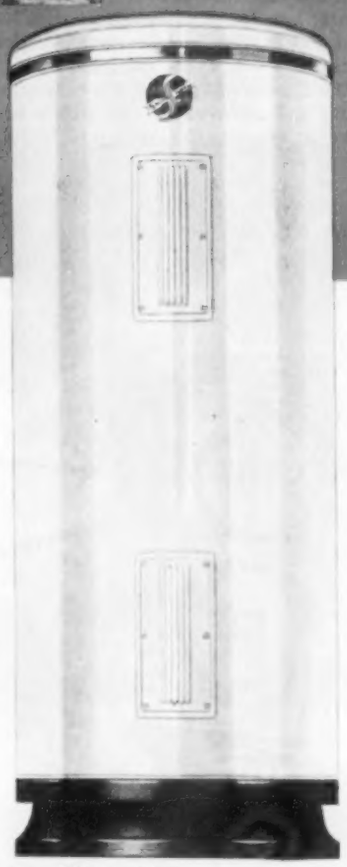
THE SIGHT FEED GENERATOR COMPANY

Sale: Richmond, Indiana • Factory: W. Alexandria, Ohio



SMITHway Electrodes in action—Mass-production welding of both ends of SMITHway *Permaglas* Automatic Storage Water Heaters completes one tank each 1½ minutes.

Production LINES BECOME Profit LINES WITH SMITHway WELDING ELECTRODES



WELDING a glass-lined head to a glass-lined shell is quite a trick in itself. But with automatic welding heads and SMITHway electrodes, the setup shown above welds at the rate of 80,000 water heater tanks per year.

Day in and day out, mass production line jobs are taken in stride through the use of SMITHway electrodes. More and more manufacturers are including welding as a better method of fabricating most steel products.

Write for SMITHway Welding Electrode Catalog, and make the most of Welding as a production tool in your own operations.

Buy an Extra War Bond This Month!

Mild Steel . . . High Tensile . . . and Stainless Steel WELDING ELECTRODES

made by welders . . . for welders

SMITHway Welding Monitor trains better welders, faster.

SMITHway A. C. Welding Machine saves power; eliminates arc blow.

SMITHway Certified WELDING ELECTRODES

A. O. SMITH Corporation

NEW YORK 17 • PITTSBURGH 19 • CHICAGO 4 • TULSA 3
HOUSTON 2 • DALLAS 1 • LOS ANGELES 14 • SEATTLE 1
International Division: MILWAUKEE 1 • In Canada: JOHN INGLIS CO., LIMITED

A LETTER TO THE EDITOR

THE LINCOLN ELECTRIC COMPANY
12818 Coit Road,
Cleveland, Ohio

May 2, 1945

My dear Sir:

The greatest handicap to the full application of arc welding to industry is the lack of technical standards covering electrodes. We have been struggling with this problem for the last twenty-five years, without a technical specification. In spite of that, there is no one in the WELDING SOCIETY who is working on the development of such standards. The only approach to such standards is the present so-called "purchase specifications" being developed by the Filler Metal Committee. These "purchase specifications," however, cannot be used for control of product in actual production.

First, they do not apply to small electrodes.

Second, the time required for testing even one electrode is over 100 man-hours. Hence, any lot of electrode that is being used and is questioned cannot practically be tested under these specifications.

Third, present "purchase specifications" would not allow electrodes which would make a deposit homogeneous with the parent metal.

This lack of proper standards cannot be allowed to continue if the welding industry is to serve the public properly.

The following suggestions are advanced as indications only, as to the direction in which a proper technical standard might go.

1. That the weld should be as strong as the parent metal.
2. That when the weld is made and bent, the outside fibers shall show an elongation of at least 25% without fracture.

If a porosity specification is desired, the following could be used:

3. A test joint shall be welded in plate and broken open through the weld. In any straight line in the fracture, at least 95% of the weld metal shall be free from porosity.

Such a specification would assure welds which would never fail in an actual structure, under any imaginable conditions. It is simple, the test can be made immediately on any batch of wire at any time, and with very little effort. There would be no doubt as to the electrode being satisfactory if it would pass these tests.

Very truly yours,
(Signed) J. F. LINCOLN, *President*

[Editorial Note.—The new A.W.S.-A.S.T.M. Specifications for Iron and Steel Arc Welding Electrodes—Serial Designation A233-45T will appear in the August 1945 issue of THE WELDING JOURNAL.*]*

V. E. DAY—AND THE PART WELDERS PLAYED*

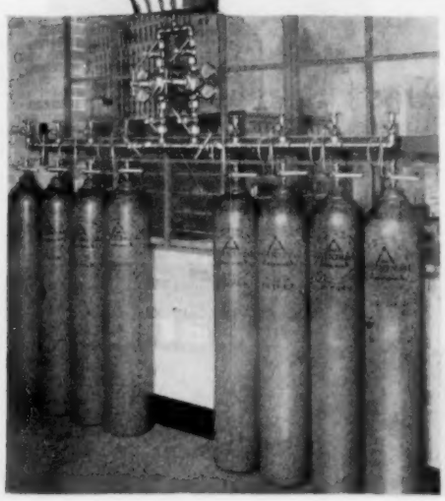
On May 8, 1945, the United States, England, Russia and our other Allies proclaimed V. E. Day, the day on which hostilities in Europe ceased, ending one of the world's greatest conflicts for the preservation of democracy. V. J. Day is still to come, and we are expected to carry on, because until Japan is defeated our fighting forces will depend on us, and until then we will continue doing our job just as well as we have in the past.

We welders have been doing our job, satisfied with the results of our efforts, never asking for or expecting glory or honors, being satisfied that we contributed much to bring about victory. However, a summarization of our efforts is appropriate at this time, and a composite picture will give us cause for a greater satisfaction and realization of our efforts, not only by us welders, but it will be a means of presenting to others the importance of the part we played in the war.

In the aircraft industries including hundreds of companies building planes and aircraft accessories, welding has been utilized in their production lines. Other companies have welded ships, barges, P.T. boats, L.S.T.'s and other watercraft. Industries engaged in the production of refrigeration equipment, shells, guns and

* Submitted by I. A. Crawford Mfg. Eng., Member A. W. S.

Are YOUR WELDING OPERATIONS LIKE A TRAFFIC LIGHT?



● You can eliminate costly "Stop-Go, Stop-Go" operations in your shop by installing the RegO Manifold designed for your requirements.

You not only gain the advantage of uninterrupted operations, but also save valuable production space and eliminate hazards, time and trouble caused by wheeling full and empty clinders through a busy department.

Learn about *all* the advantages you can get with RegO Manifolds . . . there's no obligation . . . write today!

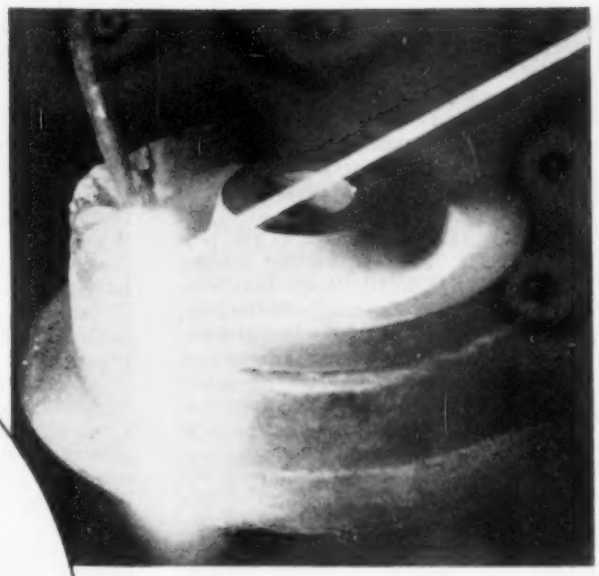
REGO ARMY E NAVY

The BASTIAN-BLESSING Company

4241 Peterson Ave. · Chicago 30, Ill.

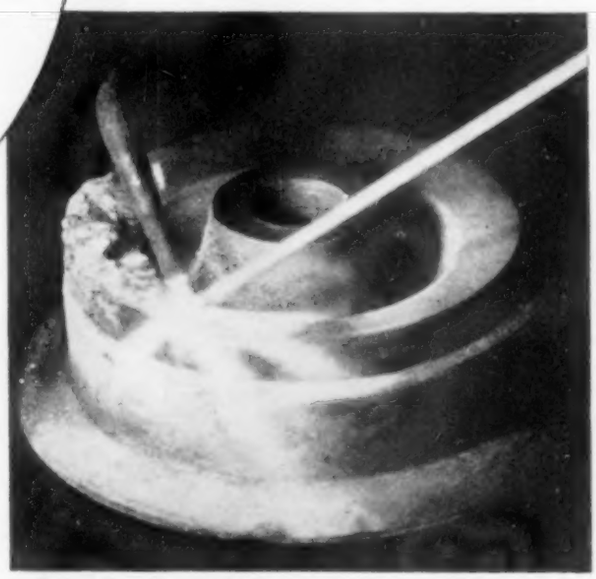
Pioneers and Leaders in Equipment for Using and Controlling High Pressure Gases

SCREEN OUT THIS SODIUM FLARE



AO Noviweld Didymium Lenses

PRESERVE ORANGE & RED VALUES



Noviweld-Didymium Lenses enable the welder to look right through cloudy yellow sodium flare and see the rod and molten area clearly — with full protection against the dangerous hazards of ultra-violet and infra-red rays.

With a *clearer* picture of his work, the welder can lay *cleaner* beads. As a result, secondary operations — chipping, grinding and wire brushing — cost less in time and money.

Right now, you can get immediate delivery of Noviweld-Didymium Lenses for the welding goggles of *all* of your operators in shade numbers 4, 5 and 6. Phone, wire or write to your nearest AO Branch Office.

American Optical

COMPANY

SOUTHBRIDGE, MASSACHUSETTS

other ordnance supplies have utilized welding. We welders have made possible the meeting of production schedules, thought impossible a few years ago. Remember when our Government asked for fifty thousand planes a year? In 1944 statistics show that ninety-five thousand planes were produced. We welders helped make that possible.

Welding was predominant in the production fields; however, without welding in other fields, V. E. Day might have been delayed and V. J. Day might be far, far, away. Remember Pearl Harbor, and the wanton destruction by the Japs, of our naval equipment on Dec. 7th? In a few days after the attack, salvage work was started, battleships which the Japs thought were damaged, were able to again steam out of the harbor and play an important part in naval engagements. The salvage and reconditioning of the battleships was possible because welding and cutting were utilized. Portable welding equipment at the battle fronts made it possible to send damaged tanks, trucks, jeeps, etc., back into battle, hastening the defeat of the enemy.

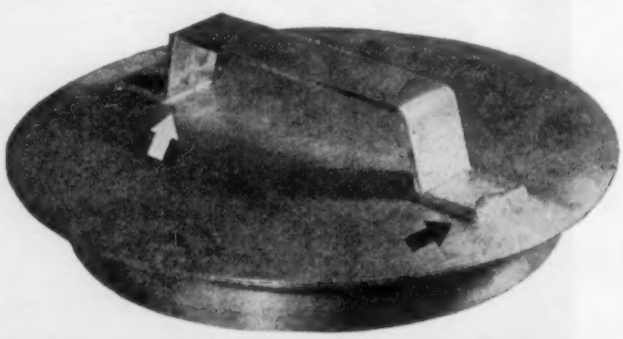
Remember the early days of the war in the South Pacific and the C. B.'s? Enlistments of personnel, experienced as welders, were offered ratings as an inducement for enlistment. The C. B.'s made it possible for the boys who were to come later, to prepare for a more aggressive warfare against the Japs. Living quarters, fuel tanks, air strips, roads, etc., all representing problems—problems made easier because of welding. This is also true of battleships, damaged in battle, or due to a serious breakdown of a part of the mechanism. In many instances, the ship would become easy prey for submarines, but again welding was utilized and the repair was made in time for the ship to rejoin its convoy and proceed under the protection of the navy battleships.

Welding has not been confined to war production, but has been the means of solving problems on the home front. Without welders the transportation of food, clothing, machinery, etc., would have bogged down. Thousands of trucks are on the highway, because a broken part, that could not be replaced, was welded. Farm equipment, that has passed its normal useful life is still being used to produce foods, due to the fact that by welding, the equipment can be kept operating. When V. J. Day comes, and we return to a normal life, free of the tenseness of war, let us give thanks to the welder and the job he did. When we see the reflections of a bluish cast reflected in the sky, as we drive along after dusk, emitting from a window or a skylight of an industrial building, let us remember that the welder, clad in overalls, leather apron, leather gloves and leather sleeves, his face hidden behind a hood, is at work, and that his efforts did contribute much to V. E. Day, and that he is doing his best to bring V. J. Day nearer, as are others in industry, making it possible for our boys in uniform to defeat the enemies of Freedom, a bit easier.

WELDING RESEARCH WILL IMPROVE POSTWAR PRODUCTION

That scientific research has more than justified its existence in the field of electric resistance welding by extending the usefulness of this high-production process to important new fields was the opinion expressed recently by Charles Eisler, president of Resistance Welder Manufacturers Association. Reviewing the progress which had been made during the war production period, Mr. Eisler pointed out that at the inception of this production, there were two ways indicated to save weight. One way was to use light metals and high-strength, low-alloy steels. The second was to use resistance welding for assembly, because this process does not require the use of any additional fastenings and therefore adds no weight to the assembly. The high speeds at which resistance welds were made represented an additional advantage.

However, metallurgical difficulties were encountered in the welding of many of these materials and it soon became evident that procedures would have to be modified, and process controls improved, in order to obtain the weld quality that was required. The industry promptly joined forces with several interested agencies to sponsor a large group of research projects, directed at the solution of these problems. This research has been bearing fruit. Stored energy types of resistance welding machines were developed which are capable of delivering the high currents needed



ALUMINUM WELDING PROBLEMS OVERCOME BY KRE-CO BRAZING

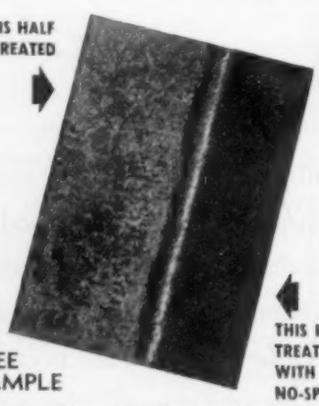
Brazing Aluminum is not tricky when you use the KRE-CO ALUMINUM BRAZING PROCESS. A simple method for completing a perfect bond even with thin gauge aluminum. The process makes brazing possible at a temperature safely below the melting point of the parent metal. A 5% Silicon Rod may be used. Request Bulletin J6.

KRE-CO MULTICHEMIC FLUX
DIVISION OF
CHARLES W. KRIEG CO.
52-60 Dickerson St. Newark 4, N.J.

for

BETTER WELDING
at
LOWER COST

THIS HALF UNTREATED



THIS HALF TREATED WITH NO-SPAT

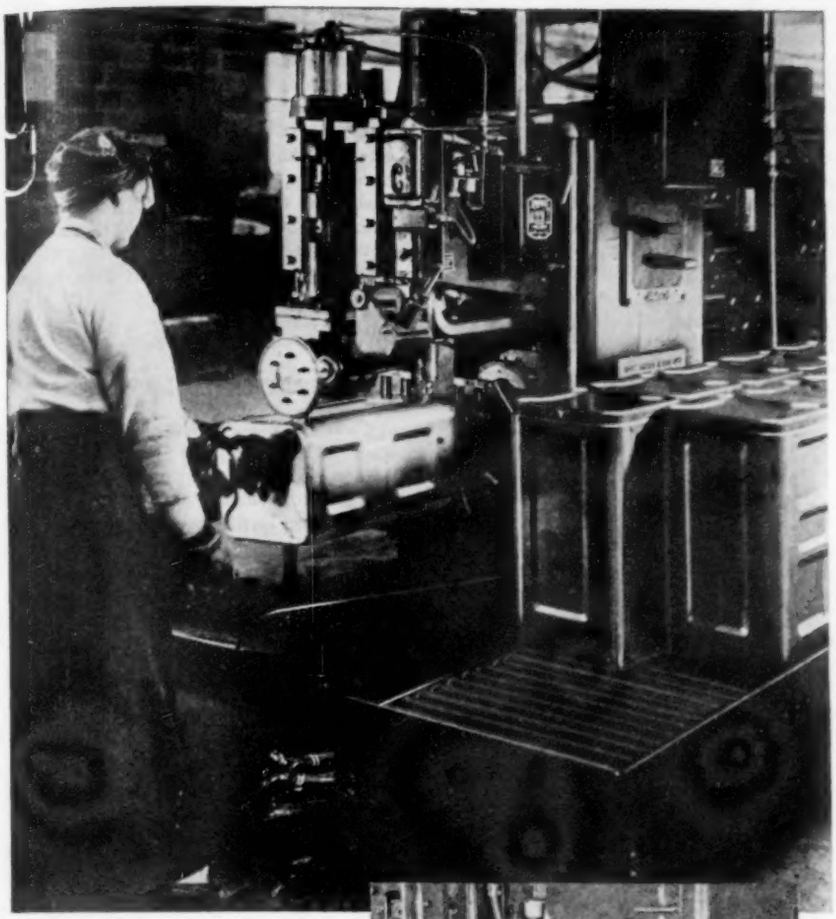
FREE SAMPLE

NO-SPAT

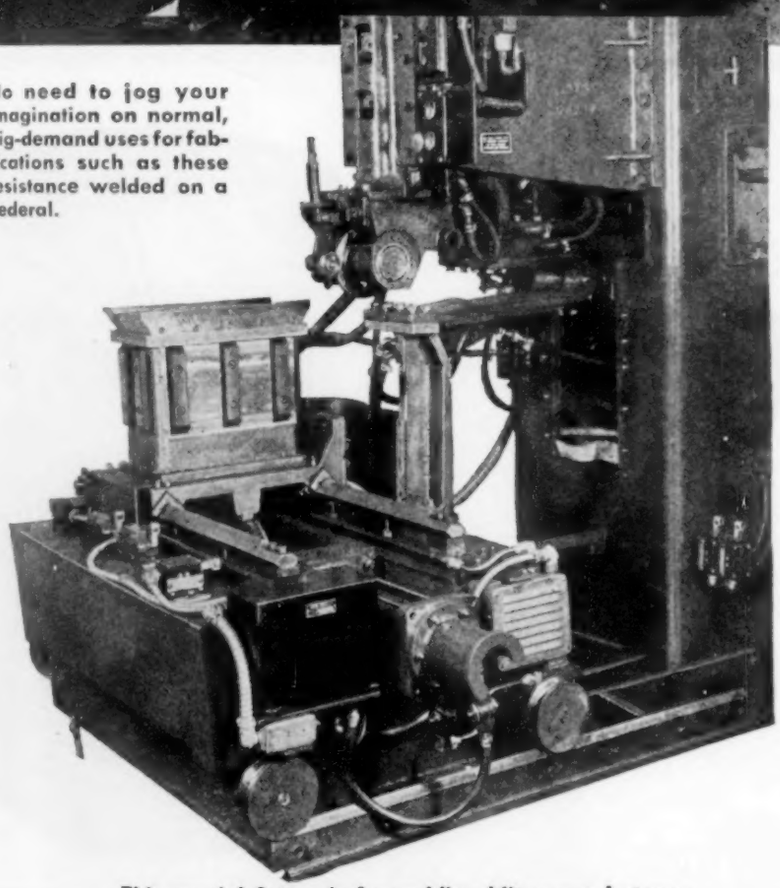
The Welding Fluid That Is Non-Toxic

NO-SPAT prevents welding spatter from adhering to metal surfaces — protects metal against rust — saves time and labor costs. Especially valuable in keeping welding jigs clean. Unbiased scientific tests show NO-SPAT maintains maximum welding strength — reduces fumes 30 percent — does not produce carbon monoxide. Extremely inexpensive. No mixing required. No time wasted. Apply and start welding at once. Write for FREE SAMPLE and detailed engineering test Bulletin.

THE MIDLAND PAINT & VARNISH CO.
9126 Reno Avenue Cleveland 5, Ohio



No need to jog your imagination on normal, big-demand uses for fabrications such as these resistance welded on a Federal.



This special fixture is for welding blitz cans, but you can quickly sketch many other shapes that could go into production on this machine.

WELDER CO. 206 Dana Street WARREN, OHIO

VERSATILE MODERN PRODUCTION TOOLS

400 WELDED PAILS PER HOUR

An ingenious application of automatic resistance seam welding to the fabrication of five-gallon pail bodies has been developed by The Federal Machine and Welder Company, is currently producing 400 bodies per hour for a large manufacturer of containers. Operator merely inserts formed body in special indexing fixture, presses foot pedal. Balance of operation is automatic, including ejection of finished body. Still greater production is in sight with design improvements newly added to this machine, which is adaptable to fabrication of any cylindrical container, not restricted to five gallon capacity.

WELDING RADIO TUBES

Producing metal radio tubes in vast quantities with a low percentage of "leakers" is a problem. It is being very successfully done by projection welding on an ingenious press type welder developed by The Federal Machine and Welder Company. The machine produces a triple weld . . . welding the socket to the filament assembly and these to the casing. It is all done in one operation, automatically indexed and producing 2500 tubes per hour.

HOW BARRELS ARE MADE

Latest informative book to come from the press under the sponsorship of The Federal Machine and Welder Company is one describing in detail a complete steel barrel production plant designed and built by Federal. Built for army supply base use, the plant employs equipment adaptable to peacetime container fabrication, has a capacity of 70,000 barrels (55 gallons) per month. A limited quantity of these books are available to designers and fabricators of containers sufficiently interested to write, giving company name and individual title.

MORE ABOUT SPOT WELDERS

Condensed information on spot welders that is particularly useful to anyone not familiar with their application is featured in new bulletins now available for free distribution by The Federal Machine and Welder Company. "Type R" bulletin describes rocker arm machines for general utility welding. "Type P" bulletins are on the subject of press type welders for a wide range of spot, projection, "Percussion" and mash welding.

for welding the light metals. Weld quality and production rates were both improved by cooperative studies of surface cleaning procedures for aluminum. Use of the oscillograph for measuring welding current and welding pressure provided a valuable method for evaluating the effects of these variables on weld quality and for establishing satisfactory procedures. Investigations of surface contact resistance provided a valuable control of the effectiveness of surface cleaning solutions. Satisfactory spot welding of hardenable steels was made possible by new techniques, involving the post heat treating of spots in the welding machine immediately after welding.

Mr. Eisler commented that these new applications are all possible with conventional equipment, and that the modifications of procedure to get the desired weld quality are extremely simple. The metal fabricating industries will, in fact, be able to utilize practically all of the wartime research, which has already paid for itself in increased production.

NONMAGNETIC USES OF MANGANESE STEEL

"Non-Magnetic Applications for Amsco Manganese Steel" is the title of the first comprehensive work published on that subject; a 32-page illustrated bulletin just issued by the American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

Presented in this bulletin are studies with illustrations of typical applications where nonmagnetism and the ability to withstand shock and wear were equally vital factors in the selection of manganese steel. These applications include lifting-magnet cover plates, collector shoes, fingers for stator cores, magnetic separator drums and rollers, electric furnace parts, aircraft instrument testing devices and a number of railroad applications. These studies may point the way to the solution of many problems including welding. The story of manganese steel and the company's research facilities are also covered in Bulletin 1144-NM, which will be mailed on request.

NEW MANUAL ON PROJECTION WELDING

Projection welding, its part in the field of resistance welding and its applications in connection with headed and threaded products is the subject of a manual entitled "Projection Welding" recently issued by the Ohio Nut & Bolt Co. of Berea, Ohio.

The manual discusses the adjustments with respect to heat, pressure and time so necessary in the welding operation to the obtaining of the perfect weld; just how and why the development and the use of the electronically controlled machines have facilitated the making of those adjustments; the economies effected and the superior bonding and fastening results obtained thereby in the assembly and subassembly part of present-day industrial production.

The manual points out that complementary to the contribution which the electronically controlled machines have made toward facilitating making the adjustments necessary in the welding operation has been the progress made in the development of the weld bolts, nuts and kindred products which are also designed to accomplish that end.

CUTTING TOOL PRACTICE

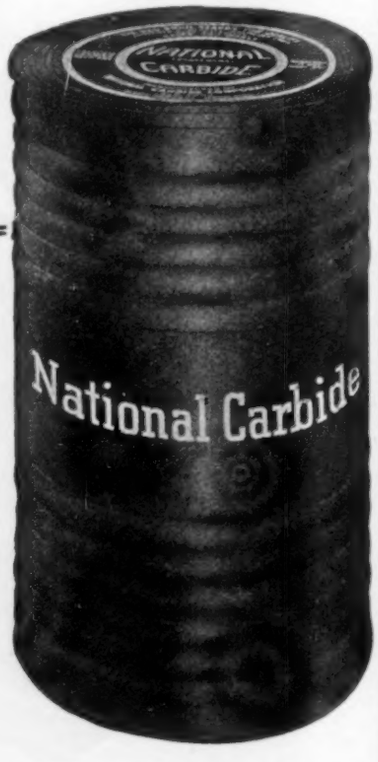
Cutting Tool Practice, by H. C. Town, and D.Potter. This book is a companion volume to *Jig and Fixture Practice*, and contains a considerable amount of information on the latest developments of metal cutting tools. This applies not only to single-point tools, but to multi-cutting tools of some complexity developed for high production purposes, while tools for the newer cutting operations such as down cut and negative rake milling, diamond tools and specialized hobbing are given much prominence.

The characteristics of the different cutting materials are fully described and the appropriate heat treatments suggested along with information on the means of sharpening.

The book will prove of assistance to all engaged in the use or design of cutting tools or the machines using them, and particularly in Technical Colleges to engi-

National
Carbide
IN THE RED DRUM

EFFICIENT
ECONOMICAL
DEPENDABLE



FOR WELDING and CUTTING
Use National Carbide in the Red Drum
60 E. 42nd St. NATIONAL CARBIDE CORPORATION New York, N. Y.

Two brazing operations are required for each gas-type circulating water heater, joining the inner and outer coils to the two pipe castings—make four Phos-Copper joints in each.

NOW...3200 JOINTS PER DAY BRAZED WITH PHOS-COPPER

...a tip to design engineers!

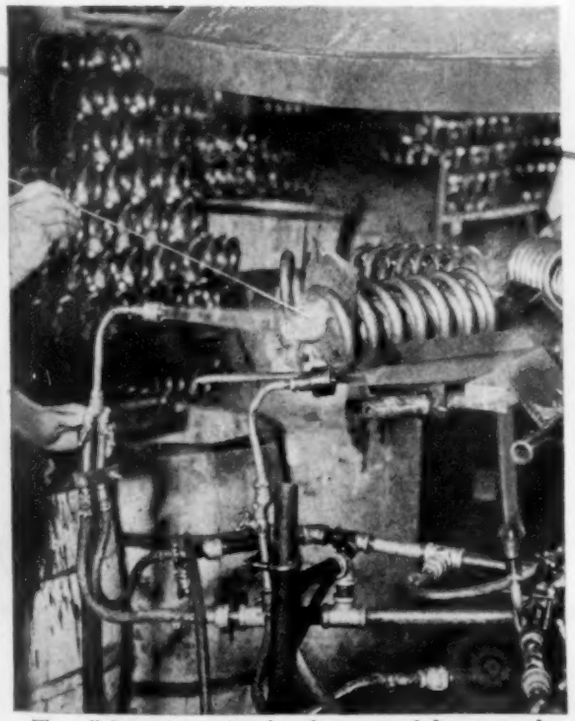
You get high production speed—and eliminate costly machining time—when you use Phos-Copper brazing. With this process, many cast and machined parts are being replaced by structures built up from simple, easily produced components.

With Phos-Copper brazing of copper, bronze and brass, tests have shown joints stronger than the parent metal...corrosion resistance equaling the parent metal . . . electrical conductivity 98% as great. Its low, free-flowing temperature permits the brazing of light sections.

Phos-Copper brazing may be done in any of five ways—by gas, incandescent carbon, dipping and electronic heat and in a furnace. Phos-Copper comes in rod, strip and special shapes.

Because of the many advantages, Phos-Copper is replacing tin and silver-base solders. For further information on Phos-Copper, ask your Westinghouse representative for book B-3201. Or write for it, to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-90556



The coil being brazed has just been rotated from two other positions where gas flames preheated the joints. The flame at the brazing position maintains the heat and flows the ⅛-inch Phos-Copper rod. The ten-position rotating fixture produces 1600 brazing operations of two joints each, or 800 coil assemblies per shift.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Phos-Copper Brazing

neering students taking the Higher National Certificate in Production Engineering, or the City and Guilds of London Examination in Machine Shop Engineering. Price $3.50. Paul Elek (Publishers) Ltd., Africa House, Kingsway, London, W.C. 2.

AMPCOLOY BRONZES

Ampco Metal, Inc., Milwaukee 4, Wis., have just issued Bulletin 59, describing their Ampcoloy alloys, a series of bronzes of controlled analysis.

The new bulletin contains photomicrographs, physical properties and chemical compositions of the Ampcoloy series. Among Ampcoloy alloys are aluminum bronze, high lead, bronze, tin bronze, manganese bronze, beryllium copper and high conductivity alloys.

Copies of the new Ampcoloy bulletin will be sent on request to Ampco Metal, Inc., Milwaukee 4, Wis.

X-RAY DIFFRACTION APPARATUS

The Picker X-Ray Corp. of 300 Fourth Ave., New York 10, has just issued a new bulletin on the above subject. The bulletin contains a complete description of the Picker products, but readers of THE WELDING JOURNAL will particularly be interested in this bulletin since it contains a section devoted to the application of X-ray diffraction and gives typical diffraction radiographs and their interpretation. Copies of the bulletin will be gladly sent upon request of the company.

FLASH WELDING

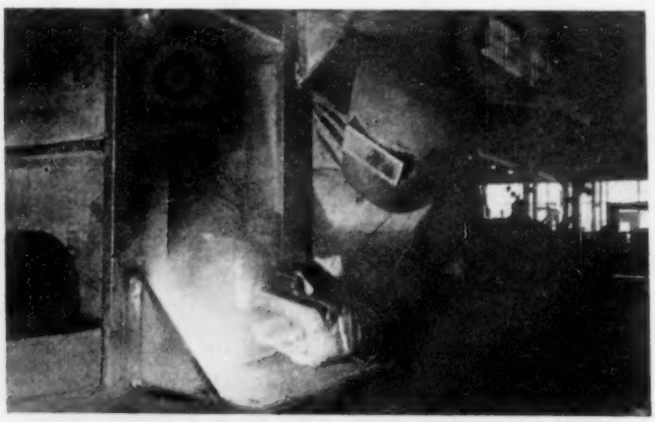
"Flash Welding—A Solution to Assembly of Forged Parts" is the title of a new 4-page, 2-color folder produced by The American Welding and Manufacturing Co., Warren, Ohio, and available upon request. A description of the advantages of flash welding as a saver of machine time, stock, weight and handling is liberally illustrated with data and pictorial examples. Methods by which welded assemblies cut production costs are also described.

THE FUTURE OF WELDING

The annual booklet of Victor Equipment Co., 844–54 Folsom St., San Francisco, tells Victor stockholders, employees, distributors and customers something about its company, the welding industry in general, and gives a glimpse into the future possibilities. Its historical sketches are interesting and instructive. The products of the company are well diversified.

CASS TO FOOTE MINERAL

Foote Mineral Co., Philadelphia, makers of welding rod coating ingredients, announces the addition of Boyd E. Cass to their staff. Mr. Cass, in his capacity as Welding Engineer, will render a technical service to industry. He majored in chemistry at Grove City College, Pa., and was formerly with Carnegie-Illinois Steel Company, Youngstown, Ohio, and Senior Metallurgist at Baldwin Locomotive Works, Eddystone, Pa. Mr. Cass is a member of the AMERICAN WELDING SOCIETY.



BEHIND THE SCENES AT
United Welding

Submit your drawings for cost estimates or feel free to consult United engineers.

There you will find the latest in facilities, including sand blast equipment, annealing ovens . . . everything necessary for the production of welded products or parts in great volume.

There you will find operators long skilled in fabricating parts laid out by engineers equally skilled in design.

Weldments of great size and weight . . . simple or complicated . . . a few parts or runs of many thousands.

WELDING ENGINEERS · UWCO · MIDDLETOWN, OHIO

SINCE 1913

THE UNITED WELDING CO.
MIDDLETOWN, OHIO
WELDING FABRICATORS OF MODERN DESIGNS

Is this YOUR Cleaning Problem?
Preparing Aluminum Surfaces for Spot Welding
Are you interested in successful shop-tested practices for properly preparing aluminum prior to spot welding? Do you want timely information that will help you to handle preparation work faster, more effectively than ever before? Then send for a copy of the Oakite Surface Preparation Manual.
The data contained in this specially-prepared Manual will enable you to obtain more welds...better welds in less time. Details of the necessary equipment are augmented by informative diagrams. Your FREE copy will gladly be sent on request.
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Technical Service Representatives Conveniently Located in All Principal Cities of the United States and Canada
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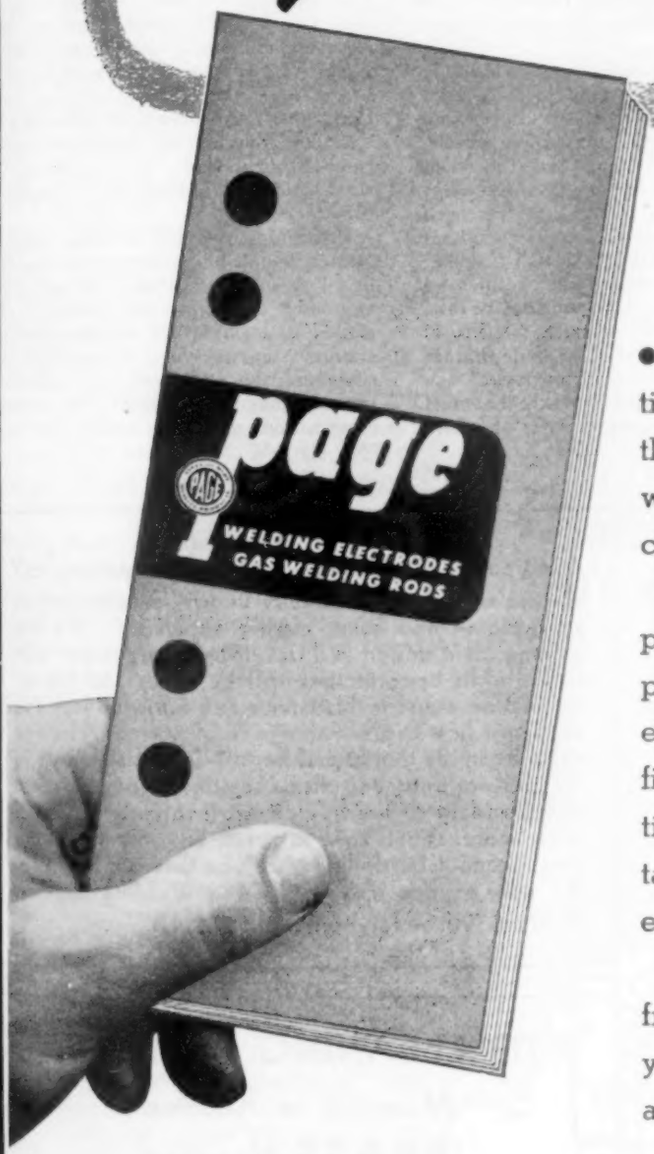
CLEANING
FOR EVERY CLEANING REQUIREMENT

PAGE *Welding* ELECTRODES

IT WILL SOON BE *Dog-Eared* FROM USE



● This new **PAGE** book is so informative, so complete and so easy to use, that we prophesy in many shops it will soon become dog-eared from constant use.

Twenty-eight different classes of production welding are listed. Opposite each is the recommended electrode or gas rod. Complete specifications and welding characteristics of each electrode and rod are tabulated for quick reference and easy reading.

You can get copies of this book from your **PAGE** distributor. Or, if you prefer, write to the **PAGE** factory at Monessen, Pa. Ask for DH-821.

ACCO

Monessen, Pa., Atlanta, Chicago, Denver, Los Angeles, New York, Pittsburgh, Portland, San Francisco, Bridgeport, Conn.

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AMERICAN CHAIN & CABLE

HESS PROMOTED

Dr. Wendell F. Hess, widely known for his research in welding processes and consultant to shipbuilding, aircraft, steel and metal companies, has been promoted from associate professor to professor of metallurgical engineering at Rensselaer Polytechnic Institute.

Recipient of the Lincoln Award of the AMERICAN WELDING SOCIETY for a paper "representing the greatest contribution to the advancement and use of welding for the year 1944," much of Dr. Hess' work during the war has been in the improvement or development of welding methods to speed production of war matériel.

Promoted at the same time from assistant to associate professors were: Dr. William H. Rauscher, chemical engineering; Dr. Joseph S. Kinney, civil engineering; Dr. Warren C. Stoker, electrical engineering; Richard W. Schmelzer and Jay Reid Gould, English; Harold A. Wilson, mechanical engineering; Augustus A. Jones, metallurgical engineering; Kenneth H. Moore, physics; and Roland H. Trathen, technical mechanics.

PREFABRICATION OF POSTWAR HOMES

Experience and knowledge gained from wartime design are focusing attention upon the use of steel in the prefabrication of postwar homes, said Milton Male, research engineer, U. S. Steel Corp. of Delaware, in a discussion of future construction techniques. With growing appreciation of the advantages inherent in steel, as well as a better understanding of some of its construction limitations, he added, the building industry will doubtless find many new uses for this versatile metal when the war ends.

Steel has long been utilized in housing for such purposes as lathing, trim, roofing, windows, and for plumbing, kitchen and bathroom equipment, Mr. Male pointed out, and new uses include structural framing and covering, for which the steel is cold formed to the desired shape from the originally flat, light gage sheet or strip less than $\frac{1}{8}$ in. thick. He asserted that special emphasis is being laid upon steel for the single-family, shop-prefabricated home.

"Compared with other common building materials," Mr. Male said, "steel has high strength. In light gage steel for structural purposes, the minimum tensile strength is 55,000 psi., and the yield strength (the more important criterion for design) 33,000 psi. This great strength offers wide opportunities to designers and architects, especially for house framing. It must be remembered that residential loads are relatively light and that to take advantage of steel strength, structural members frequently may be made thinner than practicable for other purposes."

In summing up, Mr. Male said that steel not only offers the prefabricator of homes the advantages of strength, durability, dimensional stability, and easy and economical fabrication, but also incombustibility and "the consequent reduction of fire hazards, always an important factor in public acceptance."

CHEMICAL FORMULARY

The metal and alloy industry will find much of interest and utility in the recently published Volume VII of *The Chemical Formulary*. Behind this simple title there are 2500 formulas for making almost anything easily, quickly and inexpensively, including a large section devoted exclusively to the field of metals and alloys. Edited by Harry Bennett, holder of eleven chemical patents, these formulas represent millions of dollars and years of research by the country's foremost chemists. *The Chemical Formulary* is unique, being the only large-scale collection of formulas covering the industrial-agricultural-chemical field. It is published by the Chemical Publishing Co. of Brooklyn, N. Y. (Price, $6.)

Containing over 150 formulas, Chapter XII on metals and alloys covers the field in a long index of formulas ranging from aluminum plating to zinc coatings. Included are formulas for the passivation of stainless steel wire; for rustproofing; for silver mirrors on glass; for corrosion-proofing magnesium alloys; for foundry composition, mold and wash; for hard

Reach for
DUCTONE
(E6011) AC (E6013)
WELDING RODS
Available again, after three years of war service. DUCTONE AC rods are designed and manufactured especially for AC welding. It is the best rod for all position and general purpose welding. DUCTONE AC rods have deep penetration, are good on dirty materials and operate on exceptionally low current. Small sizes are especially good for thin sheet metal. Excellent for vertical and overhead welding on DC positive polarity. Extruded in all sizes from 1/16" to 1/4". See your dealer.
Territories Available for Distributors
DUCTONE AC ELECTRODES
Chicago Steel and Wire Co.
103rd St. and Torrence Ave.
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Reach for DUCTONE AC Welding Rods

Are you the Welding Engineer we are looking for? We are an old and nationally known manufacturer of gas welding and flame cutting apparatus. We are looking for a design and development engineer with vision. His opportunities will be many and his remuneration equal to his talents and knowledge. He will know how to work alongside of others. His age might be in the thirties and he will have experience in the gas welding and flame cutting processes and understanding of the equipment involved. He will know more about how to reach an objective than why it cannot be done. Are you that man? In reply write to Box V-164, % The Welding Journal, 33 West 39th Street, New York 18, N.Y.

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BRASS *Handled*
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LARGE STOCK
PROMPT DELIVERY
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NEW MEXICO STEEL CO.
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Making Stainless Steel Electrodes is a McKAY Specialty . . . Using them is yours!

Here is a Helpful Booklet About *Welding Stainless Steel*

McKay Stainless Steel Welding Electrodes are "tops" in quality. There are good reasons for this leadership.

Among these are the standard McKay practices of: (a) Continued research in the Mellon Institute at Pittsburgh, Pa., as well as in our own laboratory at York, Pa.; (b) Analyses and correct selection, before coating, of *all* core wires; (c) use of *either* Titania or Lime Coating as preferred by you . . . not just one coating for all grades; (d) Every "batch" pilot tested before production; (e) production runs crack tested, pad analyzed, weld metal analyzed, physically tested . . . or all of these if necessary . . . to *prove* quality; (f) Exact analysis stamped on each package and certified upon request. These precautions, plus most modern production facilities, assure you of complete uniformity and successful performance.

You can weld better with these better electrodes! To test your knowledge of practical stainless steel metallurgy, ask for your free copy of the new booklet, "Things to Know About Welding Stainless Steels."

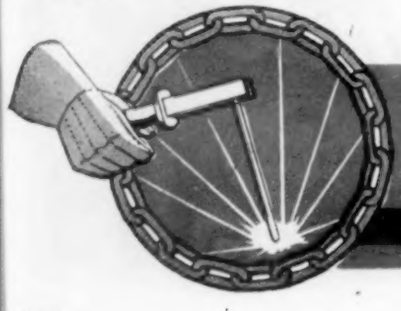
TRY YOUR HAND AT THESE QUESTIONS ABOUT STAINLESS STEEL

		TRUE	FALSE
14.	A Stainless steel electrode operated on reverse polarity sends its metal droplets across the arc against the stream of the electrical current.	☐	☐
15.	When welding stainless steels a short arc is preferable to a long arc.	☐	☐
16.	In order to be certain of the alloy content of welds the user of stainless electrodes should specify the analysis of the electrode core wire.	☐	☐

ANSWERS: 14. True. 15. True. 16. False.

Questions 1 to 13, inclusive, have appeared in preceding advertisements.

General Sales Office: York, Penna.



THE McKAY COMPANY
PITTSBURGH, PA.

WELDING ELECTRODES . . . COMMERCIAL CHAINS . . . TIRE CHAINS

noncorrosive gold jewelry alloy; for dental filling alloy, for the various solders; welding flux and many others too numerous to mention.

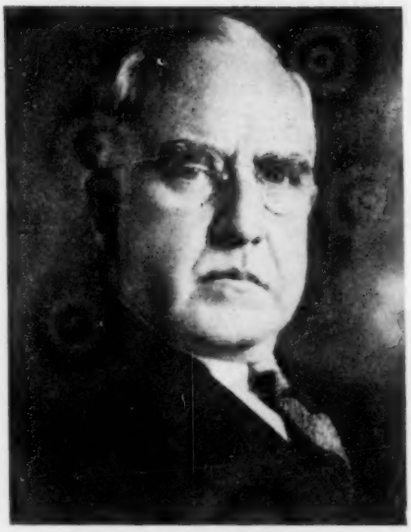
A new volume of *The Chemical Formulary* is issued every two years by the Chemical Publishing Co. Each of the seven volumes is different and can be used separately or as a set. Directions for making the formulas are simple and direct. It is possible to mix any desired amount of the product in question. In addition, the volume contains an index giving the names and addresses of mail order firms handling ingredients which otherwise might be difficult to procure.

Volume VII of *The Chemical Formulary* can be obtained at any bookstore or by mail order.

HASSE PROMOTED

Frank C. Hasse has been elected Vice-President, Mechanical Department of The Oxweld Railroad Service Co., a Unit of Union Carbide and Carbon Corp. Mr. Hasse has been associated with The Oxweld Railroad Service Co. since 1913.

Mr. Hasse's long career in the railroad industry began in 1904 with The Atchison, Topeka and Santa Fe System. Thereafter he was successively a fireman on the Chicago, Burlington and Quincy Railroad, roundhouse foreman and subsequently general boiler foreman with the Illinois Central System. Mr. Hasse started as an instructor with his present company in 1913, and was assigned to the Chicago main office in 1916.



Frank C. Hasse

Early in World War I Mr. Hasse entered the Army as a captain. He became superintendent of construction at Camp Normyle, San Antonio, Texas, and subsequently held the post of commanding officer of this camp. Shortly after rejoining the company in 1919, Mr. Hasse was made Superintendent of Construction and Maintenance, and in 1927 was appointed General Manager.

Mr. Hasse has long been prominent in the promotion of education and training in oxyacetylene welding. He is a member of the AMERICAN WELDING SOCIETY, Master Boiler Makers Association, American Society of Mechanical Engineers, Western Railway Club and the International Acetylene Association. He is also a member of the Canadian Railway Club and an overseas member of the Institution of Welding Engineers of London, England.

WELDING RESEARCH COUNCIL APPOINTS W. SPRARAGEN AS DIRECTOR

The Welding Research Council of the Engineering Foundation has announced the appointment of W. Spraragen, present executive secretary of the Council, to the newly created position of Director. The Welding Research Council is a cooperative scientific research organization which is engaged actively in the study of matters related to the science and art of welding. Sponsored by the AMERICAN WELDING SOCIETY and the American Institute of Electrical Engineers it operates in close cooperation with all major engineering societies. It has an annual budget of more than a quarter of a million dollars and these funds for research are provided by large users of welding and welded products, and various governmental agencies.

WRITE FOR CATALOG

We manufacture a complete line of resistance spot welders from ¼ to 300 KVA for all types of welding. There is an EISLER WELDER for every purpose.

TRANSFORMERS OF ALL TYPES

WE INVITE CONTRACT SPOT WELDING IN LARGE OR SMALL QUANTITIES.

CHAS. EISLER
EISLER ENGINEERING CO.
779-SO. 13th ST. Near AVON AVE. NEWARK, 3 N. J.

Opportunities in Research

Unusual postwar opportunities will be available at Battelle Memorial Institute for qualified research men now in the services or engaged in war research.

This endowed industrial and scientific research institution will add a selected number of competent scientists to its staff just as rapidly as they can leave their present war responsibilities. The men chosen will be given every opportunity to develop in their professional fields and to apply their scientific knowledge to the solution of industrial problems.

Such men will find modern scientific tools available for their use in the well-equipped Battelle laboratories, and they will be aided by a comprehensive program of fundamental research designed to expand their knowledge and their ability. Battelle operates in an unusual atmosphere which has a strong appeal to the professional research man. Opportunities for further education, technical growth, and administrative responsibility exist.

Experienced research men in the fields of chemistry, chemical engineering, electrochemistry, physics, metallurgy, fuels, light metals, plastics, ceramics, mechanical engineering, design and product engineering electrical engineering, applied mechanics, mining, raw materials, and allied technical professions will be considered.

Whatever your postwar plans may be, inquire now about these opportunities at Battelle. Write to:

BATTELLE MEMORIAL INSTITUTE
COLUMBUS 1, OHIO

Time Counts—
Gas cut and Weld with

Shawinigan Carbide

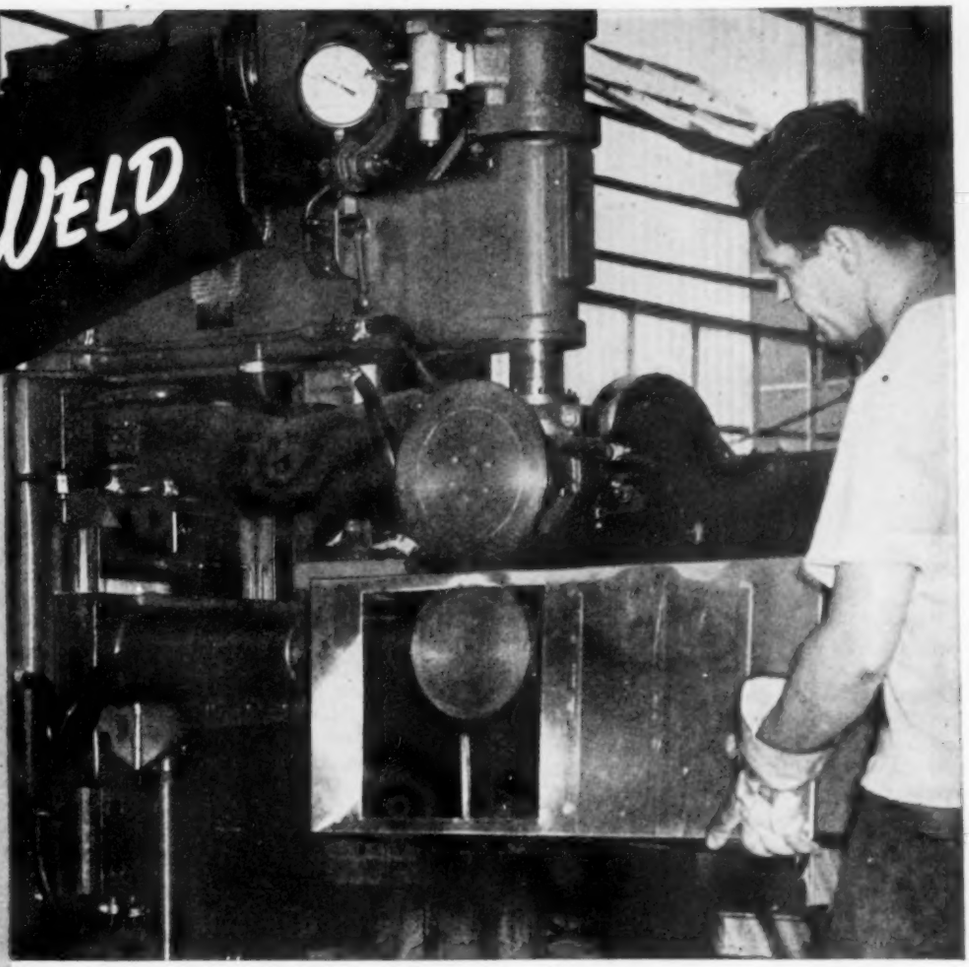
SHAWINIGAN

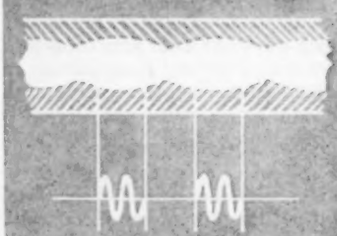
FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

SHAWINIGAN PRODUCTS CORPORATION
EMPIRE STATE BUILDING, NEW YORK 1, N.Y.

SEAM WELD

...when it has to be watertight





Schematic cross section diagram of a seam weld. Interrupted current is generally used and produces a succession of overlapping spot welds. Electronic timers control the sequence of a typical setting: 2 cycles weld time and 2 cycles off time. Current values slightly higher than used for single spots are required due to the shunting of the adjacent weld.

FAST Higgins landing craft must use distilled water in the cooling of their power plants. It is essential that the distillation unit be both sturdy and splash-proof.

In fabricating this unit, Higgins Industries, Inc. uses *seam welding*. The Sciaky welder above is speeding the production of distiller cabinets. A single sheet of 24 gauge Monel metal is formed, then welded with a single longitudinal lap joint near the corner. The result is a strong, waterproof joint, produced with speeds up to 78" per minute. No special skill is required of the operator.

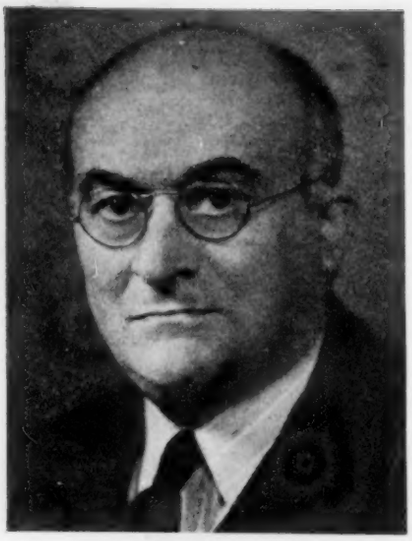
We can help you design your product to take advantage of this modern fabricating process. A variety of special wheels, mandrels and jigs can be adapted to your problem. A new booklet describing our 180 KVA series machines, including general information and tooling data is yours for the asking. Write for bulletin 113-A.

SCIAKY BROS., 4915 W. 67th ST., CHICAGO 38, ILL.

Offices in New York, Washington, Cleveland, Detroit, Los Angeles
Representatives in principal cities. Plants in London and Paris

ELECTRIC RESISTANCE WELDING EQUIPMENT

SCIAKY



William Spraragen

Mr. Spraragen has long been identified with research and welding. He has served as Executive Secretary of the Welding Research Council since its organization in 1935 and his connection with the welding industry dates back to 1918 when he was appointed Research Assistant to the Welding Research Committee of the National Council of Defense and the Emergency Fleet Corporation. From 1920 until 1934 Mr. Spraragen was Secretary of the Division of Engineering, National Research Council, and Secretary of the American Bureau of Welding from 1921 until 1936. He served as Technical Secretary of the AMERICAN WELDING SOCIETY from 1927 until 1942 and is Editor and Business Manager of THE WELDING JOURNAL, official publication of the Society, of which he has been Editor since publication was started in 1922. Mr. Spraragen was Editor of the first two editions of the Welding Handbook published by the AMERICAN WELDING SOCIETY and is the author or co-author of about 70 critical reviews of the literature on practically every phase of welding.

An important duty assigned to Mr. Spraragen in his new post will be the administration of the work of a Pressure Vessel Research Committee now being organized which contemplates the expenditure in this field of $225,000 over a three-year period.

WELDING ELECTRODES

An interesting 8-page, letter-size leaflet, has been published by the Welding Equipment and Supply Co., 223 Leib St., Detroit 7, Mich., describing the Eureka Alloy Welding Electrodes, including heat-resisting, cast-iron, bronze, copper and alloy electrodes.

FACT SHEET ON U. S. COAST GUARD ICEBREAKER *MACKINAW**

General

The U. S. Coast Guard icebreaker *Mackinaw* is 290 ft. long, 74¼ ft. abeam, displaces 5090 tons and develops 10,000 shaft horsepower. The vessel has a normal draft of 18 ft. 10 in., forward and aft.

Ship was built by Toledo, Ohio, Shipbuilding Co. The keel was laid March 20, 1943. The vessel was launched March 3, 1944, and commissioned December 20, 1944.

Power Plant

Six Diesel engines of 2000 hp. each drive six electric generators of 1375 kw. each. These generators supply power for three electric propulsion motors, one for the bow screw and two for the after propellers. Each of the stern motors is capable of supplying 5000 shaft horsepower and the forward motor 3300 shaft horsepower. All auxiliaries are electric with power supplied by four auxiliary Diesel-driven 200-kw. generators. Oil fuel capacity is 440,000 gal. The unique forward screw can rotate to advantage in either direction. It can be used to cut ice, to create a wash or vacuum, and when reversed to suck water from under an ice sheet. This changes the static buoyancy of the ice and facilitates icebreaking by the cutaway bow. Forward propeller is 12 ft. in diameter; the two after screws are 14 ft. in diameter. All propellers are three bladed.

* From: Public Relations Officer, U. S. Coast Guard.

U.S.C.G. Official Photo

Fig. 1—Coast Guard Cutter *Mackinaw* Breaking Through the Ice on St. Mary's River Followed by 3 Cargo Vessels

Plating

Plating is 1⅝ in. thick at the ice belt; 1⅜ in. thick below the ice belt and ⅝ in. thick above the ice belt. *Mackinaw* has 30 miles of single-bead welding in plating and altogether throughout the vessel 150 miles of single-bead welding. There is not a single rivet in the entire hull structure.

General Construction

General construction consists of truss frames spaced on 16-in. centers. Space between shell and inner skin is utilized for fuel storage tanks. Vessel has facilities for carrying approximately 400 tons of cargo and provisions for 6 mo. Anchors are self-stowing and are located in housing hawse-pipes so that nothing projects beyond the hull. Ship has a notched stern permitting entry of a freighter's bow during towing or icebreaking operations. Towing engine has automatic tension control which pays out 2-in. wire cable when excessive surges occur, automatically recovering the cable when the pull drops below the value at which the control is set.

Insulation

Ship is insulated against 30° below zero temperature by a 3-in. layer of cork on all outside surfaces.

Ballast Tanks

Powerful pumps in the vessel are for trimming forward and aft and heeling to

Buy "Proven Fluxes" with Years of Guaranteed Satisfaction behind them
The Trade-Name is "ANTI-BORAX"

Ask for Them *Unequalled for Quality*

A Flux for every metal: Cast Iron Welding Flux No. 1; Brazing Flux No. 2; Braz-Cast Flux No. 4 for bronze-welding cast iron; "ABC" Aluminum Flux No. 8 for sheet Aluminum and all alloys of Aluminum; Stainless Steel Flux No. 9; Silver Solder Brazing Flux No. 10; No. 16 Silver Solder Paste Flux.

ANTI-BORAX COMPOUND COMPANY

Fort Wayne, Indiana

WELDING APPLICATIONS ENGINEER

Immediately; for sales engineering staff of leading manufacturer of resistance welding equipment. Must have good engineering background and thorough knowledge of resistance welding. Although this is an old, well established company, he must team up with an organization of keen, hard working young men who will play a big part in company's promising post war development. Give full details about yourself, including age, education, experience, family. Address Box V-167, % The Welding Journal, 33 West 39 Street, New York 18, N. Y.

UP PRODUCTION

DOWN REJECTS

Flexarc ACP Electrodes speed production of sound welds in all positions . . . .

It makes a lot of difference which electrode your operators use. If they don't have a supply of the new Westinghouse ACP Electrodes, you are missing one of the most important welding developments in the past ten years.

You can speed up work with the new ACP and improve the quality of welds. The ACP rod forms a light, porous slag which can be easily removed by light brushing without waiting for the weld to cool.

And welds with an ACP electrode are strong, dense and ductile. Your operators will immediately sense a new drive and penetration with the ACP electrode. It produces excellent results in making lap joints and horizontal fillet welds. Equally important to you is the fact that the ACP is an all-position a-c or d-c electrode.

For complete information about this new electrode, write today for a copy of B-3353, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-21338

WHY ACP ELECTRODES ARE PREFERRED FOR ALL-ROUND WORK WITH A-C OR D-C

- Easy slag removal. Light porous slag permits quick removal with stroke of welding rod or light brushing . . . minimum amount of time and effort.
- No sag in overhead welds. Good flat beads . . . easy flow . . . that really stay put.
- Easy arc control in all positions . . . excellent physical properties.
- Forceful direct arc, plus excellent metal transfer, gives high penetration with complete fusion and easy manipulation.
- High speed, high burn-off rate.

ACP electrodes meet AWS and ASTM Specifications, Class E-6011 and E-6010.

Westinghouse
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

FLEXARC ACP ELECTRODES

ONE OF THE WESTINGHOUSE "BIG 5"

U.S.C.G. Official Photo

Fig. 2—The *Mackinaw* in Straits of Mackinac

The new Coast Guard icebreaker *Mackinaw* passes through the Straits of Mackinac in mid-winter convoy of shipping along the Great Lakes waterway. The *Mackinaw*, recently added to the U.S.C.G.'s fleet, is the most powerful icebreaker in the world.

port and starboard, keeping the vessel free when working on the ice. Four electric drive pumps are used to transfer 400 tons of water from port to starboard and back again in a total time of 4 min. The fore and after pump can transfer 150 tons of water in a completed cycle of 16 min. The trimming pumps can be used to place the vessel in the best icebreaking position.

Speed

Vessel recorded 18.8 miles per hour in full power runs during trials.

Cranes

Vessel has two 12-ton cranes aft to handle aids-to-navigation.

Duties

Destined to remain on the Great Lakes by virtue of draft and beam, the mission of the *Mackinaw* was clearly defined by Vice Admiral Russell R. Waesche, Commandant of the United States Coast Guard, who stated: "She will open shipping lanes probably three to four weeks earlier in the spring and keep them open later in the fall. She will be ready to aid commercial shipping whenever required to do so and to perform any rescue operations. Of imperative importance is her assignment to clear the way for new Navy construction that must move through the Lakes during the winter."

During the summer, the vessel will be used to handle the heaviest buoys on the Lakes; to carry oil and provisions to distant lighthouses and stations; to serve as a training ship for Coast Guard personnel; and to do any salvage work that is necessary.

Complement

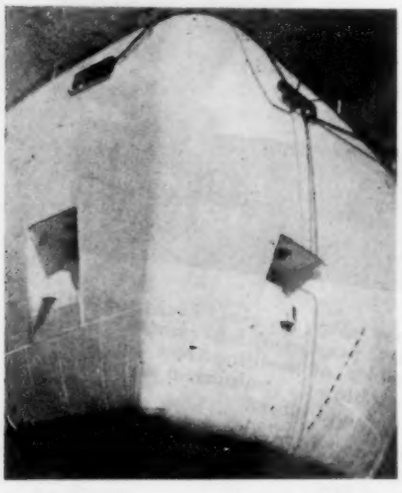
Comdr. Edwin J. Boland, U.S.C.G., of Buffalo, N. Y., is commanding officer of the *Mackinaw*. Normal complement is 10 officers and more than 100 men.

BLACKSMITH RE-SOLES HORSESHOES WITH ELECTRIC ARC METHOD

Although the process of arc welding has invaded practically every known field of metal working including the blacksmith shop, the aged art of horseshoeing has maintained a unique position as an industry in that it is still linked to such conventional tools as the forge and anvil.

Now even the blacksmith's traditional horseshoeing methods have given way to modern shielded arc welding, according to authorities of The Lincoln Electric Co., Cleveland, Ohio. The claim is based on the successful experience of Charles H. Chism, veteran blacksmith of Coshocton, Ohio, who recently visited the Lincoln plant where he explained how he builds up worn shoes by electric welding without removing and replacing the shoes on the horses' hoofs.

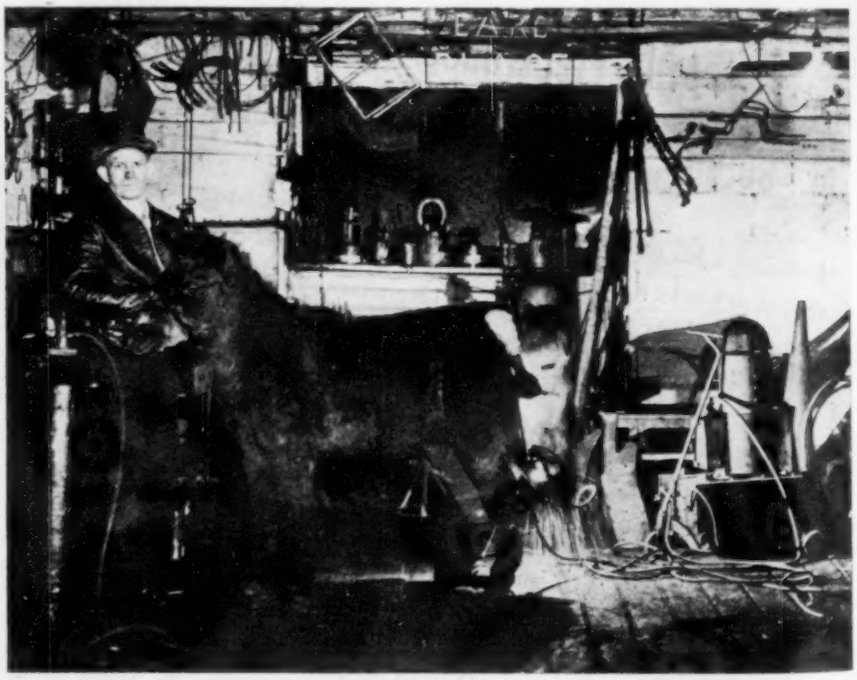
Believed to be the first blacksmith ever to successfully practice this idea, Mr. Chism produced the accompanying photo which shows him actually rebuilding the



U.S.C.G. Official Photo

Fig. 3

One-hundred fifty miles of single-bead welding and not a single rivet in the entire hull structure of the new U.S.C.G. icebreaker *Mackinaw* recently built by Toledo Shipbuilding Co., Toledo, Ohio. The anchors are self-stowing, and are located in housing hawse pipes so that nothing projects beyond the hull.



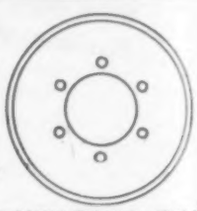
Arc Welding Worn Surfaces of a Mine Pony's Shoes as Shown Here, Introduces a New Idea in Horseshoeing According to Charles H. Chism, Originator of the Idea

"ELECTROLOY" for RESISTANCE WELDING

Butt
Flash
Spot
Seam
Projection

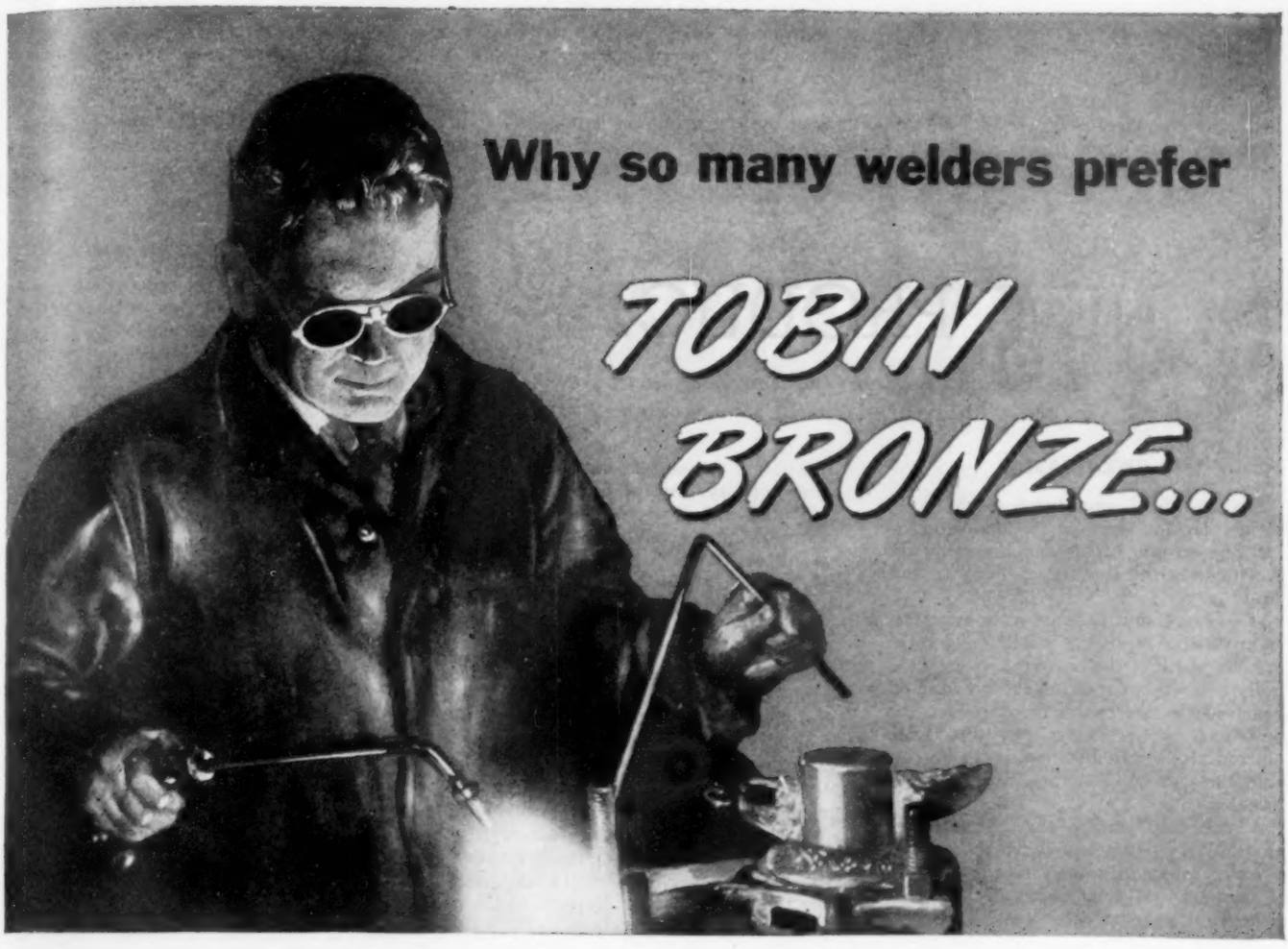
ELECTROLOY

Catalog and prices on request



OFFSET HOLDER

THE ELECTROLOY CO. INC. 1600 SEAVIEW AVE. BRIDGEPORT, CONN. WELDING ROLL



LOW MELTING POINT, 1625° F.
SAVES TIME, OXYGEN AND ACETYLENE
MAKES DENSE, TOUGH WELDS
FLOWS FREELY • UNIFORM COMPOSITION

FEW WELDING RODS combine all the advantages offered by Tobin Bronze*. That is why this general-purpose Anaconda Welding Rod is so widely used for repairs to cast and malleable iron, steel, copper, nickel and their alloys.

Quick, sound repairs with Tobin Bronze are daily putting damaged production machines back to work. As a result, "Don't Scrap It . . . Bronze Weld It!" has become in recent years a country-wide slogan for war plants.

For detailed information on Tobin Bronze and other Anaconda Welding Rods, write for Publication B-13, "Anaconda Welding Rods."

*Reg. U. S. Pat. Off. 45111

• • •

NOTE: Restrictions which have controlled our facilities and products for war purposes have been relaxed. We are now permitted, subject to any continuing requirements of the Government, to resume manufacture for many civilian uses.

Keep Faith With Your Fighters and Yourself! Buy War Bonds for Keeps

ANACONDA

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY—General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

toe and caulk of a mine pony's shoe with his shielded arc welder.

"The shoes wear down," said Chism, "especially in icy weather or in use on paved roads. Electric welding does away with the need of taking shoes off and putting new ones on for the old ones can be built up a couple of times this way very nicely." He adds that the horse's shoe does not get as hot as when originally put on in which case it is red hot so that it can be shaped to fit the hoof. After the welding operation, the horse's hoof is cooled by pouring on water. A light-coated, high-carbon electrode of 1/8 in. diameter, specially designed to resist shock and abrasion, is used for these horseshoe re-surfacing jobs.

Mr. Chism, who has been behind the anvil for 53 yrs., insists that horseshoers need not be afraid of applying the electric arc in this work. If the horse is the high-spirited type that may scare from the flash, a blanket should be held over its head and it will stand quietly.

NEW PRODUCTS

The Society assumes no responsibility for the validity of claims in this Section

SWEATBAND

An absorbent sweatband specially designed for foundrymen, welders and all workers on hot jobs is announced by the American Optical Co. of Southbridge, Mass.

The sweatband is made from synthetic sponge, 7 1/4 in. long, which covers the greater width of the brow.

By keeping sweat out of the eyes and off goggles, the sweatband helps reduce the possibility of accidents resulting from blurred vision. In addition, it is comfortable and can be easily sterilized for continual use.

A necessity during the hot summer months, the sweatband, which is long wearing, will add greatly to the comfort of workers and thus increase their efficiency.

SEEING THE ARC

A new tool has been developed for studying the Welding Arc. The Reid-Avery Co., Dundalk, Baltimore, Md., announce that high-speed *color* films have been taken at 3200 frames per second, and show the Electric Arc of both mild steel and stainless steel electrodes.

The phenomena observed in these films are extremely interesting, and definitely, refute a number of arc theories which most of us have accepted up to the present time. These films were shown for the first time at New York Shipbuilding before a large group of New York Shipbuilding personnel and Naval officers. After this they were shown at the Sun Shipbuilding and Drydock Co. at Chester, Pa., the Metallurgical Staff at Lehigh University, and a group of Naval officers and personnel at the Bureau of Ships in Washington.

ELECTRODE FOR LOW-ALLOY, HIGH-TENSILE STEELS

A new heavily covered arc-welding electrode for welding low-alloy, high-tensile steels has been announced by the Electric Welding Division of the General Electric Co. Specially designed for use on carbon-molybdenum steel in the high-pressure piping industry, this electrode may also be applied to vessels (fittings) and structural weldments of innumerable kinds.

Known as Type W-56, the new electrode operates satisfactorily on either alternating current, or direct current, reverse polarity, and its range of current is sufficiently broad to cover a wide range of plate thicknesses. A medium-long arc is recommended for best results with this electrode. It can be used in the flat, vertical and overhead positions. Moreover, it produces a relatively flat deposit, particularly in the vertical position.

Features of the new electrode include a stable spray-type arc, deep penetration and excellent creep-resisting qualities. In addition, the covering used produces an easily removed, light, friable slag, which sets up fast, thus facilitating proper manipulation of the electrode. Available in sizes 1/8, 5/32 and 3/16 in. in diameter, the new electrode meets the requirements of A.W.S. Classes E7010/E7011 and complies with the Navy Bureau of Ships specifications 46E2.

LARGER CAPACITY IN NEW P&H SQUARE FRAME WELDER

Responding to demands for larger capacity in a square frame welder, P&H engineers have introduced the new Model WA-300, which provides a W.S.R. (Welding Service Range) rating of from 60 to 375 amp. Retaining the simple, compact design which won favor for the smaller square frame welders, the large model also retains the two-part construction, single-heat control, visual current calibration and adaptability to parallel operation where higher amperage is desired.

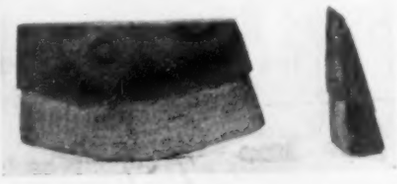
Appearing for the first time in the Model WA-300 are such new features as weather-proof construction, polarity reversing switch, and removable stator, plus overload protection both for contacts and for the new low-voltage magnetic starter. Those interested in further details may address the Harnischfeger Corp., Welding Division, Milwaukee 14, Wis.

HIGH-SPEED STEEL WELDING ROD

Bulletin 345-W on Amsco Toolface has just been issued by the American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill. This new welding rod was developed to save time and reduce costs in making, salvaging and altering cutting tools, and for hard-surfacing operations where extreme hardness and resistance to shock and corrosion are required.

Toolface is a super-hard and tough alloy tool steel welding rod composed of high carbon, high chromium, high molybdenum, tungsten and vanadium; commonly known as high-speed steel. Its welded deposits have a Brinell hardness of 575 to 675, depending on the dilution of the metal.

Toolface is especially adapted for the production of composite cutting tools, including those used on lathes, shapers, milling heads, etc. Its ready weldability expedites the depositing of cutting edges or lands on mild steel bases or shanks. This method, plus its high degree of hardness and the ease with which Toolface cutting surfaces can be dressed, results in substantial economies in tool making. The bulletin pictures the four simple steps in making a composite high-speed cutting tool with Toolface, using carbon steel as a base. Temperatures for various heat treatments for Toolface work are tabulated.



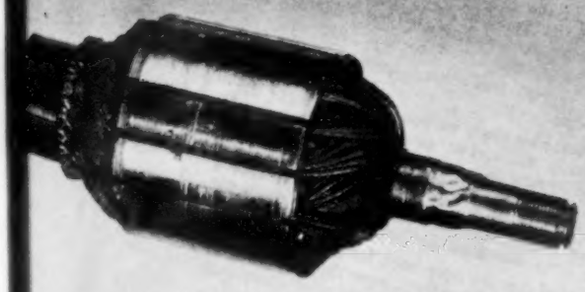
The accompanying illustration shows Toolface deposited on inexpensive carbon steel and forged to shape. It is noticeable that the line of fusion has not been affected by the forging operation. The specimens were etched in diluted hot sulphuric acid, so the resistance of Toolface to corrosion is apparent.

LOCK CLAMP FOR HEAVY DUTY

There has been a fast growing tendency, during recent years, to the use of the versatile toggle clamp as a medium for holding work securely in jigs or fixtures during various assembly and production opera-

(*Continued on page 692*)

STRESSES AND OVERHEATING



Worn motor armature shaft resurfaced by Eutectic Low Temperature Welding completely avoiding warping of shaft and preventing destruction of windings by excessive heat.

Heat-treated high-speed steel cutter would be softened by high heat of conventional welding, brazing and soldering methods. Repair at Eutectic low temperatures eliminates need for final rehardening.

Bond metals at temperatures as low as 340° F. Reduce heat consumption . . . cut welding costs!

Now, without resorting to high temperatures, you can gain the advantage of the strong bonds formed by fusion welding.

The most revolutionary welding development of modern times—EUTECTIC *Low Temperature* Welding enables you to join metals at temperatures below the fusion points of base metals eliminating many high temperature hazards of fusion welding and brazing.

Eutectic welding rods and fluxes are available for joining all metals by means of gas—arc—induction—furnace and all standard methods of heating. No extensive training or special skill is required.

Try Eutectic for Production—Salvage and Maintenance welding. Get the facts about Eutectic now . . . Fill in the coupon or write on your company letterhead.

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☐ Send me full information for purchasing *introductory assortment* of important Eutecrods for Production Salvage and Maintenance welding.

☐ Please send me a copy of The Eutectic Catalog JN1 containing complete information about Eutectic *Low Temperature* Welding and its 6 great advantages.

Name_____ Company_____

Position_____ Address_____

OCTOBER 2, 1941

WE RENEW OUR PLEDGE

Two years ago, at the beginning of the present war with its uncertainties and threats to the future of all industry, this Company publicly pledged itself not to increase its selling prices.

On this, the second anniversary, we again publicly renew that pledge.

During the last two years we have not only kept the pledge previously made, but *we have actually reduced our selling prices by more than 6%* because of more efficient operation made possible by the marvelous cooperation and ability of our organization. This was accomplished in the face of rising labor and material costs, both of which have been increased by considerable amounts.

It is our belief that the only hope for the continuance of the present industrial system now threatened from within and without is in its ability to give more and more to the consumer for less and less of his dollar. This is the strength of American individual initiative. This is the hope of our country's future. If American industry can accomplish this universally, we need not fear dictators either at home or abroad.

THE LINCOLN ELECTRIC COMPANY

Cleveland, Ohio
October 2, 1941

J. F. Lincoln
President

STATEMENT OF POLICY

The world is entering a crisis, the result of which no one can foresee. Other wars have brought inflation, followed by unemployment and depression after peace was achieved. America's experience in the World War illustrates this fact.

Much of this post-war trouble would have been eliminated by a more foresighted price policy on the part of manufacturers and distributors. Price inflation by the seller when he had a dominant position resulted inevitably in reaction with deflation, depression and suffering. Many of those price increases were not warranted.

Before such an inflationary cycle of prices is again started, we publicly pledge ourselves, as far as possible, to maintain present prices.

Further, if the materials we buy are increased in price, or the cost of labor is increased, then we pledge ourselves to raise selling prices no more than the bare increase in cost of raw materials and labor going into our products.

Further, we pledge ourselves to pass on to our customers the reduction in cost made possible by better manufacturing methods, wider distribution and technical advances in production.

THE LINCOLN ELECTRIC COMPANY

Cleveland, Ohio
October 2, 1939

J. F. Lincoln
President

OCTOBER 2, 1939

★ ★ OUR PLEDGE MAINTAINED ★ ★

On October 2, 1939, we announced the policy of "no increase in selling prices". A progress report made October 2, 1941, showed we actually had reduced prices by more than 6% during the period 1939 to 1941.

We have adhered to this policy of price reduction throughout the war years. Despite general increases in the costs of labor, materials and distribution . . . and despite governmental regulations . . . we have been able to maintain or reduce our prices throughout the entire period from 1939 to date.

This has been made possible by our incentive system . . . a method which, if it had been applied throughout industry, would have doubled America's output of war goods for a quicker Victory and would have cut the cost of the war by 50%.

America's future depends largely upon her *efficiency of production.* Our proved incentive system has in it the seeds of a satisfactory answer to the difficulties of this nature in industry.

THE LINCOLN ELECTRIC COMPANY

Cleveland 1, Ohio
May 7, 1945
Victory in Europe

J. F. Lincoln
President

tions. In step with this trend, a "Push-and-Pull Lock" type was introduced several months ago to serve in such operations as locating and indexing, and is now supplemented by a larger model for the heavier work involving the same production operations.

Known as the De-Sta-Co Model 610, this clamp can be quickly converted from "Push" to "Pull" action, or, vice versa, in a few seconds, simply by relocating one of the handle bolts, according to Glendon H. Roberts, president of the Detroit Stamping Co., 322 Midland Ave., Detroit 3, Mich. Weighing but 1 1/2 lb. and with an over-all length of 6 3/4 in. ("Push" position) this heavy duty model has a plunger rod travel of 1 1/2 in. Rod is tapped to receive a 3/8"—16 standard threaded bolt, providing quick adjustment to the work being handled. Its finish is a silvery toned rust-resistant plating.

Complete details of this new No. 610 clamp, as well as clamps for various other operations, are given in the new De-Sta-Co Toggle Clamp catalog, which can be obtained by request direct to the manufacturer.

WORK POSITIONER

A new balanced positioner offers finger tip manipulation through 360° of rotation and 135° of tilt. No need for power equipment. Reduces working time and production costs. The *center of gravity* stays in *one position* through all manipulations. A seated operator can perform assembly operations on a heavy item as easily as if holding a small part in *one* hand.

Great flexibility and higher operating speed in arc welding are achieved by the improved Bentley welding positioner. This supersedes previous models requiring power for operation and tilting only 90°. The new positioner enables work to be balanced quickly on the two axes of the rotating work table, and provides all-position downhand welding at all times for better welding at reduced cost. In this unique arrangement the Tilting Spindle is located *below* the Face Plate, permitting mounting of long structures without interference with the tilt axis structure.

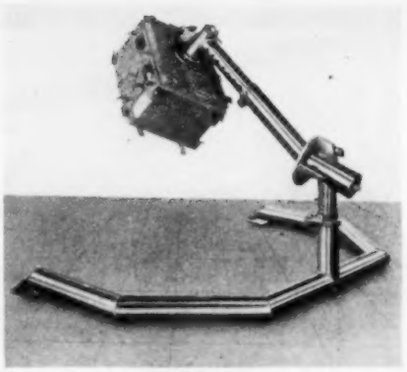


Fig. 2

The work is located on the face plate to balance about Rotation Spindle Axis X-X.

The horizontal telescopic arm is adjusted to balance the work about Tilt Axis Y-Y.

Cam-operated pins engaging index plates provide for locking the work in 15° intervals of both Rotation and Tilt. Index plates spaced to suit a specific manipulating operation can be readily substituted for the standard 15° spacing.

The face plate, together with its rotation index plate, is mounted on a flange on the rotation spindle. These can be readily removed and an assembly or holding fixture, with integral index plate, as shown in illustration, can be mounted on the flange, providing access to the underside of the work to a far greater degree than possible when work is supported on a face plate.

In changing fixtures with integral index plates, one automatically changes the rotation index cycle. By interchanging corresponding ring index plates on the tilt spindle, corresponding tilt cycles are procured.

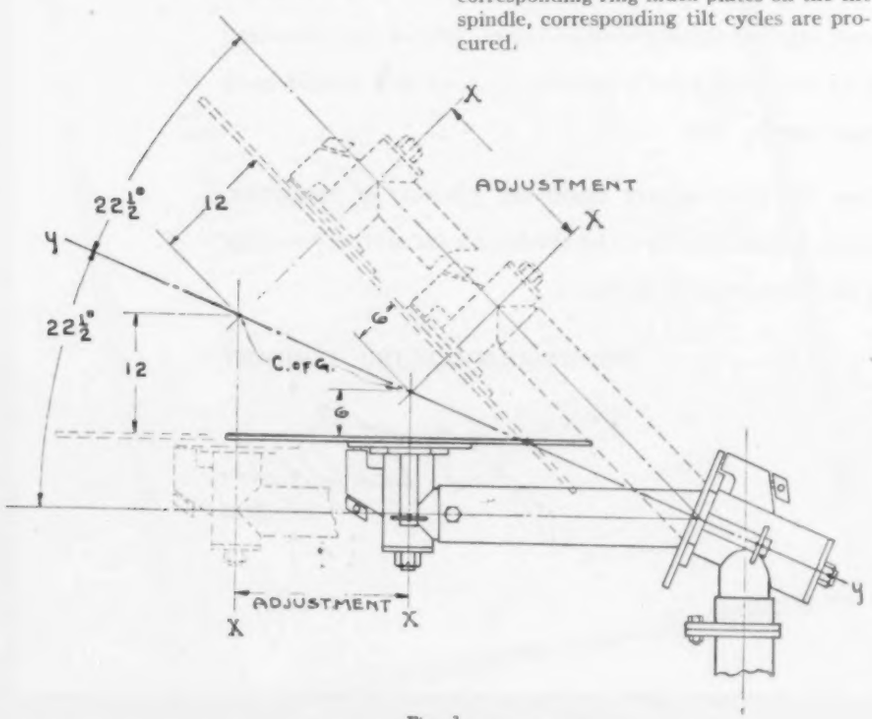


Fig. 1

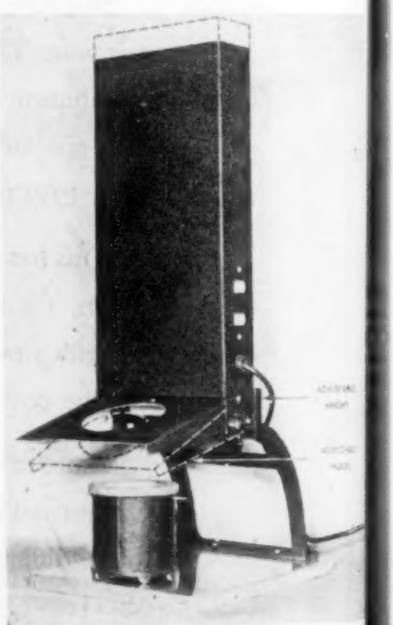
In cases where no force is applied to the work as in electric welding, spring pin indexing is often preferred. By using index plates with holes arranged to suit the desired cycle but having holes slightly smaller than the index pin diameter, this pin, which has a rounded end, serves as a spring pin instead of as a locking pin. Or a combination of spring pin and locking pin indexing can be utilized on a single index plate.

The illustration shows the tilt arm supported by a portable pedestal, having vertical adjustment, so that the height of the work can be best adjusted to suit clearance above the floor, or accessibility to the operator.

Group assembly and welding operations with complete positioning can be easily secured by mounting two or more of these units on a central hub rotating about a vertical axis. Capacity of model No. 3 illustrated is 500 lb., with center of gravity from 6 to 12 in. above the face plate. Model No. 1 1/2 with 150-lb. capacity also available. Source: Bentley Welding, Inc., Dept. B, Box 1038, Syracuse, N. Y.

SOLDERING STAND

The new model SS11 Soldering Stand, developed by the Ess Specialty Corp. of Bergenfield, N. J., embodies the flexibility required for soldering with either iron, torch or soldering pot. The hood and fume stack can be raised and lowered to accommodate any of the three heating elements used in soldering.

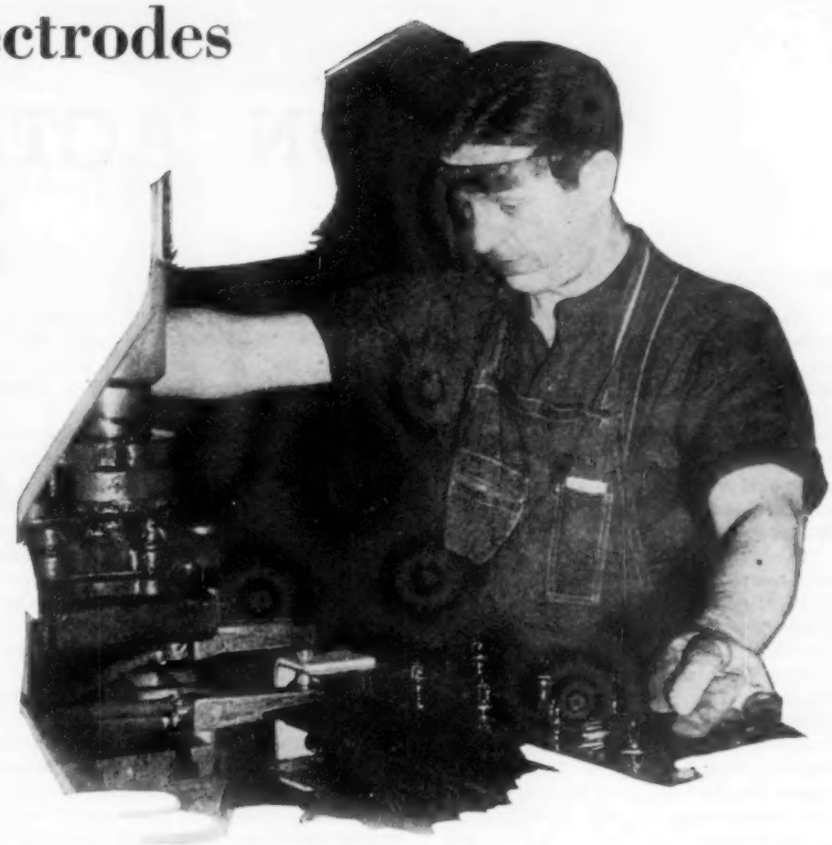


This SS11 Soldering Stand permits interchangeable soldering, greater protection against injurious fumes, minimizing hand fatigue, eye strain, etc., and increases soldering production and efficiency.

Soldering with this stand allows maximum freedom for work passing, enabling the operator to focus attention on the soldered joint by means of the plate glass window (or magnifying glass) in the hood, thus quickening the soldering pace by elimination of lost motion.

For further information, address Department SS, Ess Specialty Corp., 96 Washington Ave., Bergenfield, N. J.

MALLORY Electrodes Speed Heavy Metal Assemblies with Pulsation Welding



SPEEDIER assembly of heavy metal parts has become possible with pulsation welding—a technique of passing repeated pulses of current through the work to be welded, without changing the position of the electrodes. The pressure applied during the welding cycle may be maintained constant but in many cases it is increased substantially from its initial value in order to effect a forging action.

Effective pulsation spot welding permits the heavy materials being welded to reach a welding temperature while minimizing the heat effects in the water-cooled electrodes. This method of resistance welding thereby reduces electrode deterioration, decreases indentation and improves the surface appearance of the weld.

In the operation illustrated, ten welds are made successively in joining a copper-plated steel bracket ¼" thick to a terminal plate of ⅛" cold rolled steel. Each weld requires six pulsations—four cycles "on"; and two cycles "off".

Standard Mallory Spot Welding Tips made of Mallory 3 Metal, mounted in *standard* offset water-cooled tip holders designed and manufactured by Mallory, are used on this special job. It's typical of the versatility of Mallory Standard Resistance Welding Electrodes—tips and holders for spot welding, seam welding wheels, and dies for flash, butt or projection welding.

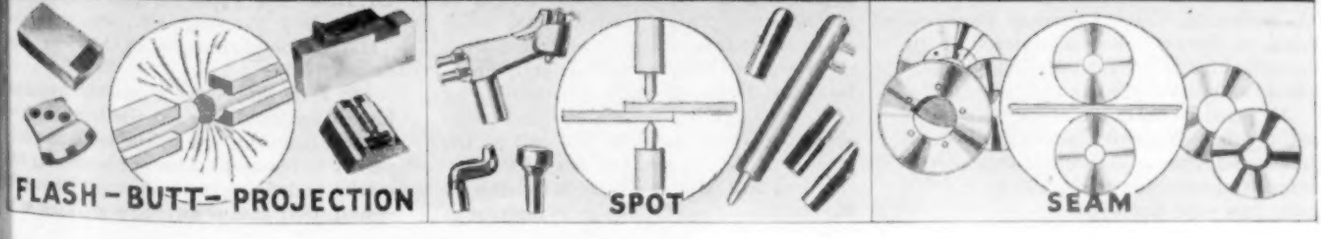
Write for your copy of the Mallory Resistance Welding electrode catalog today. Also for a copy of the Mallory Resistance Welding Data Book, sent gratis to resistance welding engineers, when requested on company letterhead. Available to students, libraries and schools at $2.50 per copy, postage paid.

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

In the United Kingdom, Made and Sold by Mallory Metallurgical Products, Ltd., London.

P. R. MALLORY & CO. Inc

MALLORY *Standard Resistance Welding Electrodes*



SECTION ACTIVITIES

CHATTANOOGA

The Chattanooga Section closed its series of meetings for the season with the annual banquet at the Chattanooga Golf and Country Club, Friday night, June 8th. An interesting session of both business and fun took place in the form of a stag dinner for members and their guests. The program also included the showing of the Lincoln film on Welding, music and a solo dancer.

The following officers and directors have been elected for the new season: *Chairman*, C. R. Miller, Sales Manager, Welding Gas Products; *Vice-Chairman*, H. H. Keep, Jr., President, Lookout Boiler & Mfg. Co.; *Secretary-Treasurer*, R. E. Brooks, Research Engineer, Combustion Engineering Co. *Directors:* J. W. Brown, Chattanooga Boiler & Tank Co.; P. W. Stuff, Ross-Meehan Foundries; H. B. Henegar, Tennessee Copper Co.; A. J. Moses, Combustion Engineering Co.; R. G. Wilson, National Cylinder Gas Co.

It is expected that the membership in the Section will increase and the achievements improve through the splendid work started by the retiring officers and their committees. Continued success is confidently looked forward to during the coming seasons.

CHICAGO

The final meeting of the season was held on May 18th. Premeeting movies were shown as follows: "The Magic Wand of Industry—Arc Welding," shown through the courtesy of The Lincoln Electric Co.; "Construction and Operation of Calcium Carbide Plant," shown through the courtesy of the Stewart Oxygen Co. The speaker of the evening, A. F. Chouinard of the National Cylinder Gas Co., discussed "Flame Shape Cutting Processes."

CINCINNATI

The May meeting of the Cincinnati Section was held on the 22nd at the Engineers Club.

The speakers, all from The Precision Welder Machine Co. of Cincinnati, and their subjects, were as follows: T. Embury Jones, President, presented the Fundamentals of Resistance Welding; E. W. Forkner, Vice-President in Charge of Operation, spoke on the sales problems of the Resistance Welding Machines; Wm. G. Bostwick, Chief Electrical Engineer, spoke on the problems encountered by the manufacture of Resistance Welding Machines and power companies.

All three speakers presented very interesting talks. A question and answer period followed. After adjournment a number of interesting samples of work done by this company were displayed.

CLEVELAND

The Cleveland Section held its annual "Welding Conference" Friday, May 11, 1945. As usual the papers and speakers were outstanding and drew a crowd of over 500.

The Afternoon Session was opened by H. O. Westendarp, Jr., of the General Electric Co., whose paper was entitled "A.W.S. Specifications as a Guide in the Selection of Welding Electrodes." Mr. Westendarp discussed the A.W.S.-A.S.T.M. filler metal specifications in detail and pointed out that knowledge of them would take a lot of the mystery out of welding and save the user's time in selecting the right electrode for the job.

This talk stimulated a great amount of interest in the specifications. It is apparent that in order to be of maximum benefit to users, that the specifications have been drawn up to show strength and ductility of deposit, positions of welding, and power supply (a.-c. or d.-c.) for each class of electrode.

Since a joint might fail due to lack of penetration, even though deposited weld metal passed strength test requirements, the specifications require electrodes to pass certain tests to determine their ability to penetrate the root of the joint.

The filler metal committee which is comprised of representatives of users and producers of welding electrodes were congratulated by Mr. Westendarp and he urged that members of the A.W.S. cooperate with the committee fully, that an even better job may be done.

This was followed by a talk from Harris A. Goodwin II of the Bastian-Blessing Co. who told of "The Use of Propane as a Fuel Gas for Flame Cutting." Mr. Goodwin pointed out the amount of oxygen required by various fuel gases to complete combustion. His slides brought out the reduced amount of oxygen used to do a specified quantity of flame cutting with the use of Propane as a fuel gas due to a narrower kerf resulting from this combination. Other slides showed various cutting jobs done with Oxy-Propane, both above ground and also under water.

George N. Sieger of the SMS Corp. followed with his usual interesting delivery of a talk on "Design for Resistance Welding." Some of his remarks were as follows:

"Resistance welding has its own field of application as an economical means of manufacturing high-quality metal products. It is fundamentally different from the fusion welding processes, and, therefore, the design of parts for assembly by resistance welding necessitates a reasonably clear understanding, not only of the nature of the process, but also of the mechanical and electrical characteristics of the equipment used. The great increase in the volume of resistance welding applications during the past five years has been accompanied by the development of many improved procedures and also by the promotion of a better understanding of design problems. Although definite advances have been made in the application of resistance welding to materials which have long been considered to be extremely difficult, the refinements in procedure and equipment to meet the unprecedented demand for volume production are of still greater importance to the design engineer, because they represent new tools which his plant can use.

"Improper design can defeat the purpose of resistance welding by making the execution of a satisfactory weld impossible. Proper design, not only assures the probability of making good welds, but also makes it possible to get the utmost production economy out of any resistance welding machine.

"Design can be considered to include: The composition and geometry of component parts; the number, size and location of welding sequence, or operations sequence; the use of jigs and fixtures; the selection of the process to be used; the process control specification; the establishment of limits of surface indentation, finished dimensions, etc.

"Each of the resistance welding processes has its own characteristic set of variables. The design engineer needs to be informed on the nature and the effect of these variables, in order to develop a procedure control which will assure satisfactory weld quality. This is substantiated by reports from metal fabricating plants, indicating quite clearly that where the process is well understood, the results are uniformly good, whereas many limitations are observed in plants where there is only a superficial knowledge of resistance welding fundamentals."

Malcom S. Clark, who was Chairman of the Afternoon Session, then adjourned the meeting for dinner which followed.

A. G. Hopcraft, the Toastmaster, did an excellent job in keeping the large crowd amused and informed before, between and after the introduction of the evening speakers.

The group was treated to an inspiring talk on the past, present and future of the art of welding by our National President, A. C. Wiegel.

The main speaker of the evening was Dr. Howard E. Fritz, Director of Research for the B. F. Goodrich Co., who spoke on "The Accomplishments of Modern Research."

Dr. Fritz dipped back into the pages of history and told how our Civilization progressed from one era to the next due primarily to research. One of his opening remarks, in defining research, was "Research —well, that means anybody working any

Miss Throckmorton Puts a V. P. Wise to MUREX FHP

This time, things are what my boss calls "quote, the same—only different, unquote."

The part that's the same is that they're stumped again out in the factory, and that here is this urgent memo yelling for help from my boss, the Vice President in Charge of Production.

The part that's different is that this time the trouble is in our new arc-welding department, and for once my boss does not know the answer.

"Miss Throckmorton," he tells me, in this half-joking way, "you used to work in an arc-welding company. What's the best 'hot rod' for horizontal and flat fillet welding, deep groove work, cover beads and other downhand applications? They want it to operate on either AC or DC, at high currents, and with a rapid deposit rate and good penetration. What shall I tell them?"

"Tell them," I suggested, "to try MUREX FHP. My last boss always called it the best 'hot rod' made. He said it was the old original rod of its type and still way out in front as first choice of most of the big fabricators."

My boss looked at me sort of pop-eyed, then tossed me the memo.

"Here," he grinned, "you tell them."

Three days later we get this enthusiastic report from the arc-welding department. They'd just tried MUREX FHP and ordered a thousand pounds of it. "*Best hot rod on the market,*" the report wound up. "*Weld metal is X-ray sound and ductilities excellent. Little spatter produced, even at high currents, and slag removes freely. Concave fillets and layers in deep groove work are produced without undercutting. In case you can spare Miss Throckmorton, we can use her.*"

That one the boss answered himself, on the phone, with a grin. "Miss Throckmorton will stick where she is," he told them, winking at me proudly. "And if you want to stick where *you* are, you'd better stick to MUREX."

P.S. Miss Throckmorton again. Besides FHP, MUREX makes about 30 electrodes for mild steel, low-alloy steel, stainless steel, and hard surfacing. They're conveniently classified and described on a big MUREX Wall Chart, of which you should have a copy. Just address:

METAL & THERMIT CORPORATION

120 BROADWAY, NEW YORK 5, N. Y.

ALBANY · CHICAGO · PITTSBURGH
SO. SAN FRANCISCO · TORONTO

MUREX *Electrodes*

place to do something different and/or cheaper." He told of the various accomplishments of science down through the years; how science and agriculture teamed together to bring us out of a world of hunger and undernourishment back in ancient and medieval times. He produced some synthetic rubber at the speakers' table by the mixture of a few simple chemicals. Dr. Fritz finished his most interesting and educational talk and the crowd was fully impressed with the need of more and more scientific research to make and keep our world a better place in which a freedom-loving people can live.

The officers for the coming 1945–46 season were introduced and are as follows: Ross J. Yarrow, *Chairman;* Kent Thornton, *1st Vice-Chairman;* Mike Shane, *2nd Vice-Chairman;* J. F. Wagner, *Secretary-Treasurer.*

A. Leslie Pfeil was accorded a great hand and it was with deep regret that the Cleveland Section accepted his retirement as Secretary-Treasurer.

DETROIT

Committee appointments for the 1945–46 season of the Detroit Section were made at a planning meeting of the executive committee held early in June at the Rackham Memorial Bldg.

Committee chairmen were appointed as follows: Membership, Henry C. Neitzel, Whitehead & Kales Co.; Publicity, Stanley H. Brams, *The Iron Age;* Vocational Guidance, A. H. Lewis, Swift Electric Welding Co.; Patrons, C. E. Phillips, C. E. Phillips & Co.; Program, E. B. Brown, The American Brass Co.; Reception, A. H. Lewis; Entertainment of Speakers, George Sloan, Jackson Products; Affiliate Council, Donald H. Corey, The Detroit Edison Co., and Leo A. Eckermann, Steel Plate & Shape Corp.

It was decided to change the regular meeting date to the second Friday of each month, in the hope of arranging programs in joint succession with the Cleveland and Toledo sections, as well as the Flint Division of the Detroit Section. The program scheduled for next year will dwell largely on reconversion of industry to civilian production and the future of welding technology in such reconversion.

HARTFORD

The February 23rd meeting was held at the Hartford Auditorium. Linden F. Bock of the General Electric Co., Bridgeport, Conn., spoke on "New Methods of Resistance Welding." Mr. Bock gave a brief history of resistance welding and basic descriptions of the methods currently in use, very well illustrated by slides, also sample board showing various samples of welded parts. A film "Birth of the B-29" was also shown.

The April 27th meeting was addressed by Charles H. Jennings of the Westinghouse Electric Corp. Mr. Jennings spoke on "Welding Distortion." A film "The Black Cats (Navy)" was also shown.

The May 25th meeting was addressed by John J. Vreeland of the Chase Brass & Copper Co., who spoke on "The Welding and Brazing of Copper Alloys." Mr. Vreeland gave a good basic summary of the problems encountered in the welding of copper and its alloys and methods of solving them. A film "Civilian Warrior" was also shown.

INDIANA

The May meeting was held Friday, the 25th, at the Riley Hotel, Indianapolis. Following the dinner, Ray Wirt, Process Engineer, Delco-Remy Division, our retiring Chairman, expressed his thanks for the cooperation accorded him during his three years as Chairman.

The following officers were elected: W. G. Morgan, Noblitt Sparks Industries, Inc., *Chairman;* J. R. Neff, P. R. Mallory & Co., Inc., *1st Vice-Chairman;* R. F. Smith, Delco-Remy Division, *2nd Vice-Chairman;* P. F. Grubbs, P. R. Mallory & Co., *Treasurer.*

As a fitting conclusion for a successful year, a picnic for members only was decided upon, for June 30th at Forest Park, Noblesville.

Following the business meeting, William J. Conley, Consulting Engineer, The Lincoln Electric Co., discussed methods for prevention of distortion and short cuts in welding procedure. This talk was amply illustrated by slides and moving pictures. Of particular interest were specific methods of counteracting shrinkage forces and examples of simplified designs for welding.

KANSAS CITY

The last meeting of this Section for the season was held on May 15th in the Pine Room at Fred Harvey's. The following officers were announced as elected: *Chairman,* A. C. Sluss; *Vice-Chairman,* George Martindale; *Secretary-Treasurer,* Perry Miller. *Directors;* H. R. E. Austin, C. E. Brown, Duane DeBrunner, Ed Cellwork, Jim Kirk, W. J. Snider.

The following committee chairmen have been appointed: Program, George Martindale; Membership, H. H. Libby; Publicity, E. D. Anderson; Exhibit, J. H. Tarbell.

The speaker of the evening was Dr. Carl A. Zapffe, Consulting Metallurgist of Baltimore, Md., who spoke on "Stainless Steels—Their Metallurgy and Weldability." He explained in a very unique manner the basic metallurgy involved in stainless steels.

LOS ANGELES

The May dinner meeting of the Los Angeles section was held May 17th, at Scully's Restaurant. Clifford Sommarstrom of Waldrip Engineering Co. gave the coffee talk. His subject was "Application of Wage Incentives to Welding Operations." He discussed in detail the succession of steps necessary to establish a wage incentive plan which will be equitable to both employee and employer. How wage incentives have proved successful in this application which is the first of its kind in this area was described by Mr. Sommarstrom.

Robert E. Hillar, metallurgist and member of the firm of Triplett and Barton, Inc., was the speaker of the meeting. His subject was "Past and Present Trend in the Application of X-ray to Weld Inspection." He very aptly described the history and development of X-ray apparatus, films and techniques. Usual and unusual applications were described and results given on research findings in the field of lightweight metals. Future developments of equipment to be built with the objective of facilitating handling in special applications were also discussed.

Timely motion pictures for the spring season were shown on the subject of fishing, entitled: "Fisherman's Paradise" and "Spear Fishing in Florida."

LOUISVILLE

The current seasonal activities of the Louisville Section came to a close Friday evening, May 18th, at the University of Louisville Auditorium with W. J. Conley of The Lincoln Electric Co. heading the program and his presentation "Welding of Low Alloy Metals" proved to be a very "meaty" subject which was highly acclaimed and mentally digested by some 75 members of the welding intelligentsia.

Dr. G. C. Williams of the University of Louisville was on hand in the capacity of "Chief Greeter" and in the absence of the regular Master of Ceremonies, R. E. Fritsch, the Section's Vice-Chairman, E.H. Dilley, took over and handled the procedure very acceptably. A large delegation from American Air Filter took the attendance honors and were headed by this firm's Messers. H. C. Powers and William Dettmar, the A.W.S. Education and Treasury committeemen, respectively.

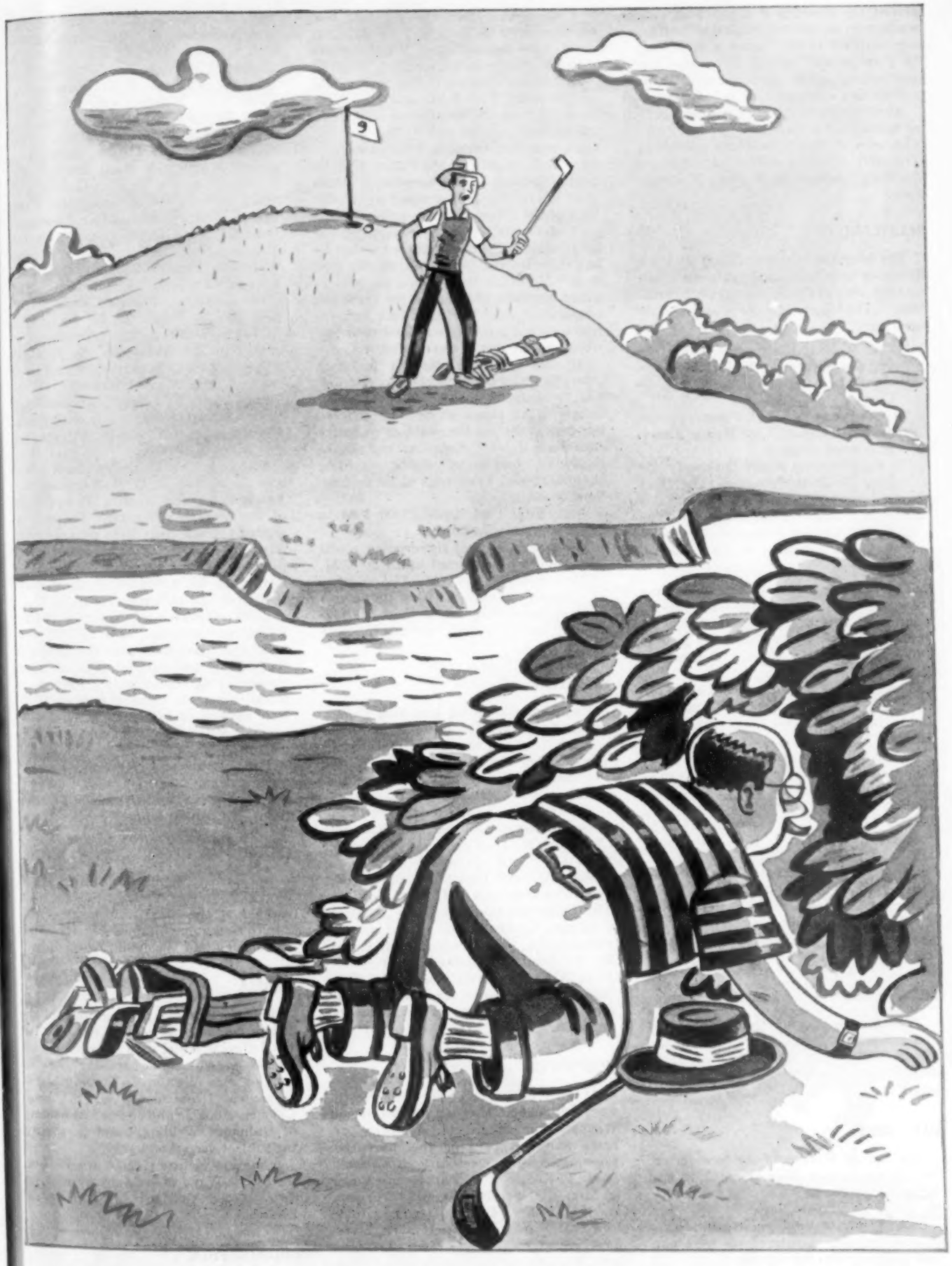
The program called attention to the fact that through the generosity of The James F. Lincoln Foundation and the courtesy of Dean Wilkinson all interested members should patronize the U. of L. Library and view the list of welding books on file there. The guest speaker, Mr. Conley, was presented with a "Certificate of Appreciation" Award appropriately framed for wall decoration.

To climax this very auspicious occasion the indefatigable co-worker, Chairman Theodore H. Lewis, was also remembered by a meritorious "Certificate of Appreciation" presented by Vice-Chairman Elmer H. Dilley and which reads as follows: "For Chairmanship and Organization Ability of the Louisville Section A.W.S. (1943–1945) and, for the comprehensive interpretation of the subject matter; for giving so generously of your talent; for welding together the human element involved; therefore creating better understanding and cooperation."

MAHONING VALLEY

At the April meeting of the Youngstown Section a petition was submitted by one of the members requesting a change in the name of the Section to the Mahoning Valley Section. This petition was accepted by the members present and subsequently submitted to the entire membership by letter ballot. The results of this letter ballot were tabulated at the May 17th meeting and were overwhelmingly in favor of the amendment.

Thomas J. Crawford of Youngstown addressed the May meeting on hard facing as applied to problems involving excessive wear in machine parts. His address in-



"I CAN'T FIND THE BALL, BUT HERE'S SOMETHING BETTER—A BRAND NEW BOX OF **CHAMPION WELDING ELECTRODES!"**

cluded the showing of a group of slides made from actual installations of hard facing materials at The Republic Steel Corp. in Youngstown. Many interesting time and money-saving applications were described and illustrated.

New officers for the 1945–46 season are as follows: *Chairman*, A. Waldo; *Vice-Chairman*, Arthur L. Williams; *Secretary-Treasurer*, H. Ross Strohecker; *Assistant Secretary* (appointed), William E. Klingeman.

MARYLAND

The Maryland Section closed its 1944–45 season with its Annual Symposium held on May 18th at the Engineers Club, Baltimore. The following is the program of the meeting.

"A.-C. Welding Electrodes—Their Uses and Classifications," by J. H. Humberstone, Director of Research, Arcrods Corp.

"Applications of High-Frequency Induction Heating," by Henry Fisher, Edgewood Arsenal.

"Is Pipe Welding Really Different?" by John H. Zink, President, The Heat and Power Corp.

Lincoln's sound technicolor movie "The Magic Wand of Industry—Arc Welding" was presented by T. A. Canty, Inc.

The following officers and committees were elected for the 1945–46 season: *Chairman*, W. H. Shaprow; *Vice-Chairman* John Gore; *Secretary-Treasurer*, Robert Fitzgerald; *Past Chairman*, J. C. Cumberland.

The following were elected to serve for three years on the Executive Committee: Louis Barrett, G. E. Claussen, M. A. Hansen, J. H. Humberstone.

Current members of the Executive Committee are: E. A. Brown, A. C. Earlbeck, C. N. Hilbinger, R. A. Mansfield, Bela Ronay. Technical Committee: *Chairman*, Geo. E. Linnert; J. W. Gore, G. E. Claussen, C. J. Phillips, J. C. Cumberland, Louis Barrett, Bela Ronay, Van R. P. Saxe. Program Committee: *Chairman*, J. H. Humberstone; E. A. Brown, C. N. Hilbinger, C. Adams, W. M. H. Ballantyne, C. D. Jensen. Publicity Committee: *Chairman*, A. C. Earlbeck; E. B. Lutes, T. O. Murray, J. E. Taylor.

MILWAUKEE

The Annual Dinner-Dance "Get-Together" was held on May 19th at the Pfister Hotel. An enjoyable evening of dinner, entertainment and dancing took place.

NEW JERSEY

The Annual Meeting of the New Jersey Section was held on May 18, 1945, at the Cedar Ridge Country Club in Livingston, N. J.

Some 40 members and guests enjoyed an afternoon of golf and the scores were not very impressive in many cases.

Luncheon was served from noontime until 6:00 P.M. and free beer was on tap from noontime until early hours in the morning.

A short executive meeting was held between 6:30 P.M. and 7:30 P.M. at which time the ballots of the voting for the new officers were counted.

A business meeting of the Section was held between 7:30 P.M. and 9:00 P.M. at which time the installation of the new officers was carried out. The new officers were introduced and the new chairman K. L. Walker of the Foster Wheeler Corp. delivered a short acceptance speech and in closing he presented G. W. Nigh of the Tidewater Association Oil Co., past chairman, with a Society pin in appreciation of the splendid work that he had done for the Section during the past year. Mr. Nigh in accepting the presentation thanked the section for their fine cooperation over the past year and encouraged the group to continue their fine work and support of the new officers.

At this time the drawing for door prizes took place. 75 prizes were distributed to holders of the lucky number tickets. The prizes which were donated by companies in the welding industry consisted of such items as cartons of cigarettes, bottles of liquor, welding equipment and accessories of all descriptions, motor oil, etc.

From 9:00 P.M. until 10:00 P.M. a buffet supper was served.

The grand finale of the evening was a floor show which started at 10:00 P.M. and lasted until 11:30 P.M. The crowd of 160 persons seemed to enjoy this entertainment immensely and anticipate a bigger and better annual meeting for next year.

NEW YORK

The Annual Meeting and Stag Dinner was held on May 18th. The Annual Business Meeting and election of officers and members of the Executive Committee preceded the dinner and evening entertainment.

The Teller's Committee reported the following elections for the 1945–46 season: *Chairman*, H. O. Klinke, Air Reduction Sales Co.; *1st Vice-Chairman*, E. B. Stolle, Midwest Piping & Supply Co.; *2nd Vice-Chairman*, H. R. Morrison, The Linde Air Products Co.; *Secretary-Treasurer*, George Sykes. The Linde Air Products Co. *Members-at-Large* (3 years): H. W. Northcutt, Bethlehem Steel Co.; J. L. Wilson, American Bureau of Shipping; Charles Kandel, Craftsweld Equipment Co.; E. V. David, Air Reduction Sales Co.

NORTHWEST

At the 8th annual meeting of the Northwest Section, held May 4th, at the Covered Wagon, Minneapolis, the following officers and members of the Executive Committee were elected: *Chairman:* Louis T. Kenny, President, Kenny Boiler & Mfg. Co., St. Paul; *Vice-Chairman:* R. H. Newton, District Manager, The Lincoln Electric Co., Minneapolis; *Secretary-Treasurer:* Alexis Caswell, Secretary, Manufacturers' Association of Minneapolis, Inc. *Executive Committee:* Walter V. Brown, President, Brown Steel Tank Co., Minneapolis; C. M. Clogston, Welding Engineer, Northern Ordnance, Inc., Minneapolis; C. E. Comfort, Plant Superintendent, St. Paul Structural Steel Co., St. Paul; Geo. O. Forseth, Welding Engineer, Metal & Thermit Corp., Minneapolis; Edgar E. Hall, Superintendent, Flour City Welding Co., Minneapolis; E. L. Hixson, Welding Supervisor, Minneapolis-Moline Power Implement Co., Minneapolis; J. I. Larson, Assistant Engineer, Stainless & Steel Products Co., St. Paul; L. L. McBurney, General Manager, Smith Welding Equipment Corp., Minneapolis; John Mikulak, Mechanical Engineer, Electric Machinery Mfg. Co., Minneapolis; F. W. Scott, Manager, Electrode Plant, Marquette Mfg. Co., Minneapolis; R. J. Stoddard, Asst. Chief Engineer, American Hoist & Derrick Co., St. Paul; C. M. Underwood, Manager, Welding Dept., Northern Ordnance, Inc., Minneapolis; T. J. Warmington, Plant Manager, Wm. Bros. Boiler & Mfg. Co., Minneapolis; M. M. Weist, District Manager, Air Reduction Sales Co., Minneapolis; J. E. Williams, District Manager, Linde Air Products Co., Minneapolis.

Walter J. Brooking, director of testing and research at R. G. LeTourneau, Inc., Peoria, Ill., and district vice-president of the AMERICAN WELDING SOCIETY, extended the greetings from national headquarters, and mentioned some of the plans that were under consideration for increasing the activities of the SOCIETY that would be of benefit to the members.

Lieut. Commander Roger F. Miller, Executive Assistant, N.R.O.T.C., University of Minnesota, was the speaker of the evening and covered some of his experiences as commanding officer on troop transports in both theaters of the war, as well as in command of ships in combat areas, including service on submarines.

The program also included motion pictures showing operations of the Navy in the Pacific area, and the English film entitled "The Robot Bomb."

OKLAHOMA CITY

Dr. Carl A. Zapffe, Consulting Metallurgist of Baltimore, Md., was the guest speaker at the May 17th meeting. Dr. Zapffe spoke on "Stainless Steels—Their Metallurgy and Weldability."

PEORIA

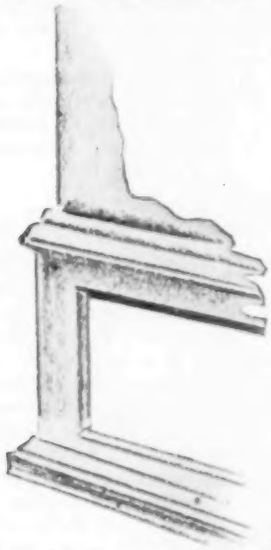
The regular monthly meeting of the Peoria Section was held on April 18th at the Jefferson Hotel with 80 members and guests present. The speaker for the evening was Weston J. Crook, Colonel, Ordnance Department, U. S. Army. Colonel Crook's subject was "Metallurgy of Ordnance Welding," and he covered the subject very thoroughly.

A motion picture titled "Arc Welding, the Magic Wand of Industry" was shown through the courtesy of The Lincoln Electric Co.

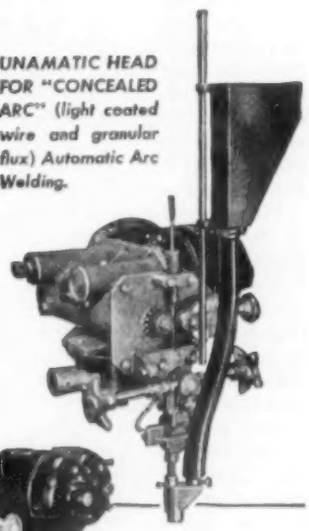
PHILADELPHIA

Final regular meeting of the season was held on Monday, May 21st, at the Engineers' Club. Dr. A. B. Kinzel of Electro-Metallurgical Co., Division of

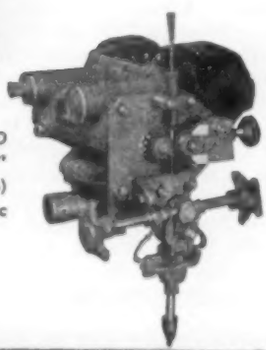
it's time to change....



UNAMATIC HEAD FOR "CONCEALED ARC" (light coated wire and granular flux) Automatic Arc Welding.



UNAMATIC HEAD FOR "PROTECTED ARC" (light coated wire and tape), Automatic Arc Welding.



UNAMATICHEAD FOR "OPEN ARC" (light coated wire) Automatic Arc Welding.

This gay young blade of the button shoe era is considerably behind the times . . . but no more so than many of the fabrication methods in use today, when compared with the modern Unamatic Arc Welding processes.

Providing the important advantages of faster production (2 to 3 times as fast as the manual process), reduced production costs (10 to 15% lower materials cost) and improved quality work, *Unamatic Welding is recognized as the modern method of metal fabricating.*

It will pay you to get the facts on Unamatic Welding. Write for complete information and our new illustrated bulletin . . . today.

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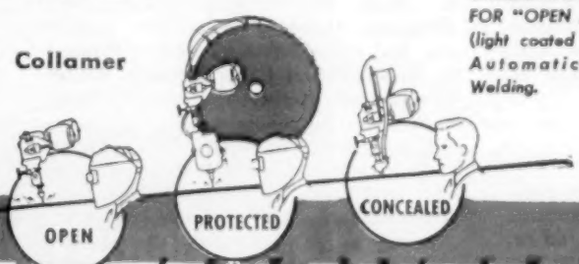


UNAMATIC WELDING

Union Carbide & Carbon Corp., spoke on "Oxyacetylene Pressure Welding."

PITTSBURGH

Honored by the presence of A. C. Weigel, President of the AMERICAN WELDING SOCIETY, the Eighth Annual Tri-State Welding Conference came to a successful close on April 27, 1945.

Preceding the Technical Meeting a Get-Together Dinner was held in the Hotel Webster Hall at which over 100 members and guests were in attendance.

Following the dinner those present were addressed by Mr. Weigel, who gave a very interesting talk on the work the AMERICAN WELDING SOCIETY is doing and what it means to the industrial plants throughout the country and he congratulated the Section on the wonderful showing it has made during the past year.

In the absence of Chairman Chas. H. Jennings, who was scheduled for a talk in the East, Vice-Chairman G. O. Hoglund took charge of the meeting and handled it in his usual efficient manner.

At the technical meeting held in the Mellon Institute following the dinner, Past-Chairman Geo. F. Wolfe of the Dravo Corp. gave the Opening Address, representing the Engineers' Society of Western Pa., in the absence of E. T. Gott, Vice-President of the Dravo Corp. who was suddenly called out of town on business.

The principal speaker of the evening, T. B. Jefferson, Editor of *The Welding Engineer*, Chicago, Ill., spoke on "Welding in the Post-War World." Mr. Jefferson's talk outlined some of the problems that face welding in the post-war era and he discussed the likely available materials that will be used by industry and the probable applications of welding in the various post-war industries.

Following Mr. Jefferson's talk, F. H. Dill, Chairman of the Nominating Committee for the selection of the officers for the 1945–46 season was presented and announced the results of the election recently held.

Those officers elected for the ensuing year who will take office at the opening meeting in October are as follows: *Chairman:* G. O. Hoglund, Aluminum Co. of America; *Vice-Chairman*, Harry P. Schane, Allis-Chalmers Manufacturing Co.; *Secretary*, J. F. Minnotte, Minnotte Brothers Co. Executive Committee (2 years): T. W. Morgan, American Rolling Mill Co.; E. J. Knapp, Metal and Thermit Corp.; R. E. Olmstead, H. H. Robertson Co. Executive Committee (1 more year to serve): R. B. Lincoln, Pittsburgh Testing Laboratory; C. E. Loos, Carnegie-Illinois Steel Corp.; Donald H. Marlin, Dravo Corp.

PORTLAND, OREGON

On Wednesday May 16, 1945, the Portland Section held their second meeting of the 1945–46 season. At 7 P.M. an excellent dinner was enjoyed by 40 members and guests.

The technical session then got under way with Carl Lodell, Chairman, presiding. After a short business session in which new members and guests were introduced, Chairman Lodell turned the meeting over to the Program Chairman, Leslie Poole.

Mr. Poole introduced G. Rheule Reitze, Field Engineer for the Nelson Specialty Welding Equipment Corp., San Leandro, Calif. Mr. Reitze's subject for the evening was "Nelson Stud Guns." He very ably covered the manufacture and development of the stud gun and its use in the post-war plan.

Following his talk, a film was shown on the "Construction and Manufacture of Rocket Guns and Shells." After Mr. Reitze answered many questions and some discussion from the members on various applications, the meeting was adjourned by Chairman Lodell.

The following officers were elected for the 1945–46 season of the Portland Section: *Chairman*, Carl Lodell, Kaiser Co. Inc.; *Vice-Chairman*, Basil McLean, American Bureau of Shipping; *Secretary*, Paul Kullberg; *Treasurer*, Paul Chatterton. *Directors* (2 years): Leslie Poole, Joe Crumley, Ray Steiner; (1 year): Tony Mikulic, Jerry Jeremiah, Tom J. Maloney.

The following committee chairmen were appointed: Program, Leslie Poole; Publicity, Wilbur C. Smith; Membership, Jerry Revell; Education & Technical, Joe Crumley.

PUGET SOUND

The final meeting of the season was held on May 23rd at the Gowman Hotel. The informal discussion before dinner was presided over by Joe Holt. The merits of both a.-c. and d.-c. welding machines were the subject of discussion.

After dinner an informal talk was given by John Severs, "Welding troubleshooter for the A. O. Smith Corp. In his discussion he brought out the merits of the different types of welding rod and the coatings used. At the completion of his talk a film on the merits of a.-c. welding machines was shown.

At this meeting the new officers for the forthcoming year were introduced and presided over the meeting as has been the custom for many years.

ROCHESTER

The following officers were elected to office at the May 3rd meeting held at the Century Sweet Shoppe. *Chairman*, Walter G. Dick, Odenbach Shipbuilding Corp.; *Vice-Chairman*, Joseph B. O'Rorke, Eastman Kodak Co.; *Secretary*, Edward R. Jones, Seneca Steel Service, Inc.; *Treasurer*, Harold J. King, The Anstice Co., Inc. *Executive Committee:* Edward G. Habel, Robert J. Raudebaugh, Walter V. Kazoroski, Herbert L. Fetter, E. Larry Smith.

The retiring Chairman, Paul Ecklund, Delo Products, and all retiring officers, were tendered a rising vote of thanks and appreciation for the past successful year.

Social activities followed the election of officers and an enjoyable evening was had by the members and guests present.

SAN FRANCISCO

Harold W. Saunders, Manager of the San Francisco District for Air Reduction Sales Co. for almost 25 years, has been made an honorary life member of the San Francisco Section, which he has served as Treasurer for more than 20 years.

He is the first member of the San Francisco Section to be so honored. In addition to his AMERICAN WELDING SOCIETY activities, Mr. Saunders has taken an active part for many years in various civic and business affairs of the East Bay and San Francisco areas.

The principal speaker at the April 23rd meeting which was held at the Hotel Claremont, Berkeley, Calif., was Thomas E. Piper, Chief Process Engineer, Northrop Aircraft, Inc., Hawthorne, Calif. Mr. Piper Spoke on "The Heliarc Welding Process as Applied in the Aircraft Industry," illustrating his talk with appropriate slides.

Mr. Piper advised of a new development, the use of a high-frequency current superimposed on the welding current which has considerable merit.

A great deal of interest was aroused by Mr. Piper's discussion. After his talk, a film entitled "The Birth of the B-29" was shown through the courtesy of the War Department. The sound projector for this showing was loaned by Victor Equipment Co. and was operated by their James Purcell.

TIDEWATER

The Tidewater Section held its regular monthly meeting for April on the 10th in the Fleet Reserve Hall, Portsmouth, Va.

The speaker of the evening, T. R. Lightenwater, representative of Republic Steel Corp., Central Alloy Dist., Massillon, Ohio, was introduced and presented a lecture on the subject, "Welding Stainless Steel and Alloys." Mr. Lightenwater also covered the welding of armor plate, and answered many questions during the discussion period.

The May 8th meeting was also held in the Fleet Reserve Hall, Portsmouth.

Mr. Kough, a Welding Specialist, and representative of Eutectic Welding Alloys Co., gave a very interesting lecture on, "Low Temperature Welding."

Mr. Lathrop, of Richmond, Va., local representative of Eutectic, exhibited many test plates and samples of Eutectic Welding, and the various rods used on alloys of every type.

WESTERN MASSACHUSETTS

A. N. Kugler, Mechanical Engineer of the Air Reduction Sales Co., New York, was the guest speaker at the April 30th meeting of this Section. Mr. Kugler's subject was "Gas Welding and Cutting." Included in the lecture was a motion picture showing the procedure and method of gas cutting under water in salvage operations, and Oxyacetylene Welding Red Brass Pipe.

The last meeting of the season for this Section was held on Monday, May 21st, at the Westinghouse Auditorium.

A vote of thanks was tendered to W. A. Emery of the Worthington Pump and Machinery Co. for his fine work in arranging the season's program.

Here's what Taylor-Winfield's FLEXIBLE PRODUCTION ZONE means to you . . . more jobs on the same resistance welder with less retooling costs

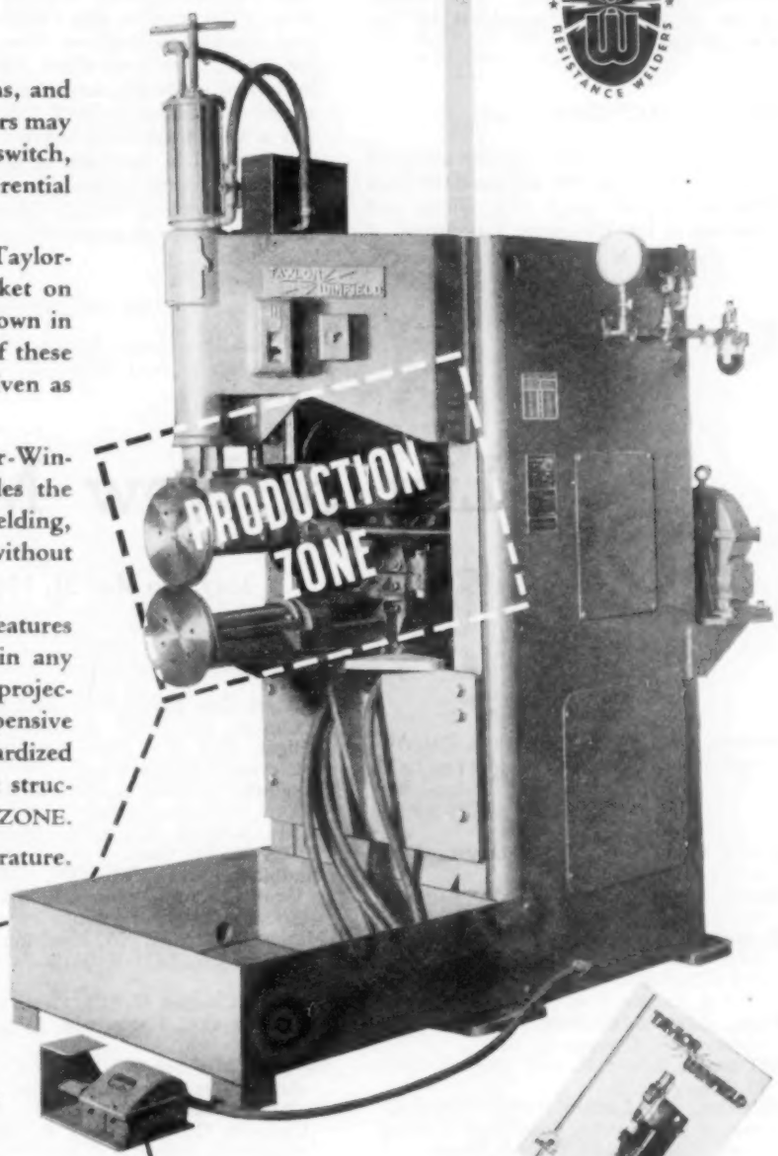
The production zone (electrodes, arms, and fixtures) of Taylor-Winfield Seam Welders may include swinging arms which you can switch, in a jiffy, from longitudinal to circumferential welding or vice versa.

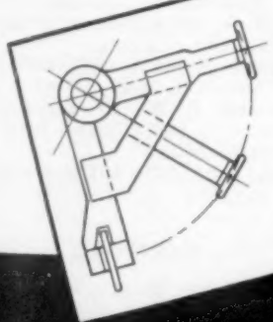
To permit even greater flexibility, Taylor-Winfield can provide an auxiliary bracket on the swinging arm for extra arms (as shown in sketch below). The circular electrodes of these extra arms may idle or they may be driven as required.

The Universal Head is another Taylor-Winfield flexibility feature; this unit enables the operator to change from one type of welding, such as longitudinal, to circumferential without time-consuming changes.

Taylor-Winfield has many patented features to help you get lowest cost per piece in any form of resistance welding (spot, seam, projection, flash-butt). You eliminate much expensive retooling when you buy a highly standardized Taylor-Winfield welder of proven basic structure with the FLEXIBLE PRODUCTION ZONE.

Write today for engineering-styled literature.





Here is a sketch of a Taylor-Winfield swinging arm assembly which makes your production zone adaptable to a variety of work.

The Taylor-Winfield Corporation

WARREN • OHIO

The Taylor-Winfield Corporation
Warren, Ohio
Send us bulletin on seam welders

Name _____

Company _____

Address _____

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The following officers and directors were elected: *Chairman*, R. W. Gamache, Welding Engineer; *Vice-Chairman*, Herbert Hill, Cheney-Bigelow Co.; *Treasurer*, H. W. Walsh, Methods Engineer, Worthington Pump & Machinery Corp.; *Secretary*, F. W. Taft, Taft Welding Equipment Co. *Directors-at-Large* (2 years): E. C. Ulshoeffer, Joseph A. Tinsman, J. E. Jones.

W. J. Conley, Consulting Engineer, The Lincoln Electric Co., delivered an educational talk on "Welding Methods and Sequences." He also described a special moving picture, "The Magic Wand of Industry," presented by The Lincoln Electric Co.

WESTERN MICHIGAN

Eighty members and guests attended the dinner and over 100 attended the May 28th meeting at which new officers and members of the Executive Committee of the Western Michigan Section were installed.

A sound colored movie "The Magic Wand of Industry—Arc Welding" was shown and enjoyed by all.

Secretary R. Dudley Layman gave a 15-minute discussion on "Fundamentals of Arc Welding." Reports received by the Section were to the effect that this was a very good meeting.

WESTERN NEW YORK

The Western New York Section held their regular monthly meeting on May 25th. The speaker was Orville T. Barnett, Production Engineer, Metal & Thermit Corp., New York City. There was a lively and moderate size attendance with a very interesting meeting. Mr. Barnett was a very interesting speaker and was instrumental in maintaining the interest of the audience until the meeting broke up.

At this meeting, the election of Officers and Directors was announced as follows: *Chairman*, Richard S. Lane; *Vice-Chairman*, Kenneth Koopman; *Secretary*, Charles Freeman; *Treasurer*, Robert Siemer; *Directors* (2 years): George Patch, M. R. Rivenburgh; (1 year): Earl Jung and William Brooks.

WICHITA

The final meeting of the season was held May 16th in the Rose Room at the Broadview Hotel.

Dr. Carl Zapffe, Consulting Metallurgist, Baltimore, Md., gave a very interesting lecture on the weldability and the metallurgy of stainless steels. A lively question and answer period followed the lecture.

New officers elected for the coming year are as follows: *Chairman*, E. A. Bussard, Coleman Lamp & Stove Co.; *Vice-Chairman*, M. L. Lampton, Phillips & Easton Supply Co.; *Secretary*, Alvie Covert, Army Air Forces-Inspection; *Treasurer*, Don Clark, Beech Aircraft Corp.

List of New Members

May 1 to May 31, 1945

ATLANTA

Sexton, John M. (B), Route 5, 301 Aircraft Apts., Marietta, Ga.

CHICAGO

Albert, Frank P. (B), 539 Forsythe Ave., Calumet City, Ill.
Braun, Charles (C), 2747 N. Kilbourn Ave., Chicago 39, Ill.
Brockman, Harold H. (B), 8004 Kenwood Ave., Chicago 19, Ill.
Casey, Charles L. (C), Scully-Jones & Co., 1901 S. Rockwell St., Chicago, Ill.
Hood, Edward Carleton (C), 1224 N. Cicero Ave., Chicago 51, Ill.
McDonald, Edwin P. (B), 2237 E. 70th Pl., Chicago, Ill.
Michelon, Lt. Leno C. (B), U.S.N.R., Bur. of Aeronautics, Gen. Rep., Central Dist., Wright Field, Dayton, Ohio.
Nicholls, Merle R. (B), 4809 Jackson St., Gary, Ind.
Robinson, R. W. (C), Argus Mfg. Co., 1134 N. Kilbourne Ave., Chicago 51, Ill.
Russell, Theodore W. (B), 1042 N. Lombard Ave., Oak Park, Ill.

CLEVELAND

Brown, Richard (C), Precision Welding & Eng. Co., 1771 E. 31 St., Cleveland, Ohio.
Butters, Charles E. (C), Williams & Co., Inc., 3700 Perkins Ave., Cleveland, Ohio.
Coon, Merritt (C), Reliable Steel Plate Co., 2330 E. 79th, Cleveland, Ohio.
Gussett, Geo. E. (C), 317—33rd St. N. W., Canton, Ohio.
Hinger, Roy (C), 3354 Henderson Rd., Cleveland Hts. 2, Ohio.
Kasdorff, Richard E. (C), 10010 Lorain Ave., Cleveland, Ohio.
Lewis, Everton (C), 11811 Beulah Ave., Cleveland 6, Ohio.
Lindblad, Alvar W. (C), Mid-States Equipt. Corp., Guardian Bldg., 629 Euclid, Cleveland, Ohio.
Mandt, Francis H. (C), Precision Welding & Eng. Co., 1771 E. 31 St., Cleveland, Ohio.
Mosher, Charles H. (C), General Tire & Rubber Co., Englewood Ave., Akron, Ohio.
Revetta, Michael (C), Lewis Co., 11811 Beulah Ave., Cleveland, Ohio.
Rodgers, Thomas M. (C), National Cylinder Gas Co., 1151 E. 222nd St., Euclid 17, Ohio.

DETROIT

Bruce, Fritjob B. (B), Copco Steel & Engrg. Co., 14035 Grand River Ave., Detroit 27, Mich.
Cox, Orville P. (C), 1935 Oakwood St., Saginaw, Mich.
Crimi, Frank V. (C), 630 Carton St., Flint, Mich.
Giesey, Boyd V. (B), 2486 Shevlin, Ferndale 20, Mich.
Irving, M. W. (C), 1015 Welch Blvd., Flint 4, Mich.
Johnson, Melville Dewey (C), Graham-Paige Motors Corp., Detroit 32, Mich.
Ketchum, Karl E. (B), Copco Steel & Engrg. Co., 14035 Grand River Ave., Detroit 27, Mich.
Moe, Carl B. (B), Copco Steel & Engrg. Co., 14035 Grand River Ave., Detroit 27, Mich.
Montayne, Robert (B), Copco Steel & Engrg. Co., 14035 Grand River Ave., Detroit 27, Mich.
Paquette, Clayton F. (B), Copco Steel & Engrg. Co., 14035 Grand River Ave., Detroit 27, Mich.
Smith, Edward (B), 7312 Middlepointe, Dearborn, Mich.
Smith, J. Wesley M. (B), 1385 Labadie Rd., Windsor, Ont., Canada.
Stead, H. G. (B), E. Leonard & Sons Ltd., London, Ont., Canada.
Whitehead, James A. (C), 15360 Princeton, Detroit 21, Mich.
Widenmann, T. W. (B), Copco Steel & Engrg. Co., 14035 Grand River Ave., Detroit 27, Mich.
Zencina, John (C), 19130 Dean Ave., Detroit, Mich.

HARTFORD

Monson, Melzar W. (C), Box 101, Manchester, Conn.
Thurz, Edward J. (C), 219 Addison St., Glastenbury, Conn.

KANSAS CITY

Dodge, A. O. (C), Air Reduction Sales, 2701 Warwick Traffic Way, Kansas City 8, Mo.
Hedstrom, A. G. (B), Kansas City Struct. Steel Co., Kansas City 3, Kan.

LEHIGH VALLEY

Yoder, Robert E. R., (C) 2243 Allen St., Allentown, Pa.

LOS ANGELES

Barnum, Lorin E. (C), 6227 Woodlawn Ave., Bell, Calif.
Bregenzer, R. E. (C), Mechanical Contractors, Inc., 537 Ceres Ave., Los Angeles 13, Calif.
Grainger, L. O. (C), 10242 Jackson Ave., South Gate, Calif.
Hales, Wilford L. (B), 194 G St., Chula Vista, Calif.
Lone, James H. (C), 1036 D Ct., Wilmington, Calif.
Orr, James H. (C), 265 N. Lemon St., Orange, Calif.
Phillips, John W. (C), 4212 E. 55th St., Maywood, Calif.
Porter, Jack (C), 9339 El Dorado, Rosco, Calif.
Ralph, Wm. Raymond (C), 758 W. 19th, San Pedro, Calif.
Renner, Ralph L. (C), 8421 Elizabeth Ave., South Gate, Calif.
Stevens, Richard Theodore (C), 211 Virginia Pl., Costa Mesa, Calif.
Straw, Herbert A. (C), 1424 W. 2nd St., Santa Ana, Calif.
Weiland, Richard (C), 2319 Saunders St., Compton, Calif.
Wood, Tom (C), 2747 Madison St., Long Beach 6, Calif.

LOUISIANA

Comfort, James J. (B), 214 Seguin St., Algiers, La.
Lee, Edward C. (B), Apt. C, 1617 Foucher St., New Orleans, La.
Mollere, Allen J., Jr. (B), 2120 Benefit St., New Orleans, La.
Moore, Joseph E. (B), 3827 Paugei St., New Orleans, La.
Neison, Lt. F. Hunter (C), U.S.N.R., 1423 Dufossat St., New Orleans 15, La.
Olson, Elven V. (B), 118 Hathaway Pl., New Orleans, La.
Stafford, Gordon (B), 6126 Canal Blvd., New Orleans, La.
Swain, Harry L. (B), 1501 Gentily, New Orleans, La.
Vicknair, Rudolph R. (B), 233 Rose Ave., Metairie, La.

MAHONING VALLEY

Atkinson, Wm. (C), 398 Pearl St., Leetonia, Ohio.

MARYLAND

Sittler, Howard L. (C), 624 Round Oak Rd., Towson 4, Md.

MILWAUKEE

Gollwitzer, Ralph (C), Huebsch Mfg. Co., 3744 N. Booth St., Milwaukee 1, Wis.
Randall, Frank J. (B), International Harvester Co., 1714 W. Bruce St., Milwaukee, Wis.

NEW JERSEY

Baron, Michael Joseph (C), 1045 Kilsythe Rd., Elizabeth, N. J.
Britton, Carroll H. (B), R. D. F. Box 1558, 997 Rahway Ave., Rahway, N. J.
Dacko, Peter (C), 264 E. 2nd St., New York City, N. Y.
Scowcroft, John J. (C), 268 Seventeenth Ave., Paterson 4, N. J.
Welsh, Edw. R. (C), 175 Mallory Ave., Jersey City, N. J.

NEW YORK

Begerow, Walter (C), Air Reduction Sales Co., 181 Pacific Ave., Jersey City, N. J.
Civay, Cuneyt (C), 41-89 Forley St., Elmhurst, N. Y.
Deike, Ernest (C), 115-114—232nd St., St. Albans, N. Y.
Durocher, Lionel E. (C), Air Reduction Sales Co., 181 Pacific Ave., Jersey City 4, N. J.
Hamilton, J. Kenneth (C), 1135 Martine Ave., Plainfield, N. J.
McKinney, Charles H. (C), 37 Remslin St., Brooklyn, N. Y.
O'Brien, Frank J. (B), Metal & Thermit Corp., 120 Broadway, New York 5, N. Y.
Ross, Victor B. D. (C), 21-27 Hazen St., Jackson Hts., L. I., N. Y.
Smith, Donald L. (C), Air Reduction Sales Co., 181 Pacific Ave., Jersey City, N. J.
Wilson, 1st Lt. Wm. F. (B), A.P.O. 75, c/o P.M., San Francisco, Calif.
Yeary, W. R., Jr. (C), Air Reduction Sales Co., 181 Pacific Ave., Jersey City 4, N. J.

NORTHERN NEW YORK

Immer, Wm. L. (C), General Electric Co., Electric Welding Div., Schenectady, N. Y.

NORTHWEST

Edison, Sigurd (C), 2325 James Ave. N., Minneapolis 11, Minn.

OKLAHOMA CITY

Dwyer, John W. (C), Mideke Supply Co., 100 E. Main, Oklahoma City 2, Okla.
Peak, W. R. (C), W. R. Peak Service, 144 N. E. 38th, Oklahoma City, Okla.

PEARL HARBOR

Lohri, Albert E. (C), 515½ 11th St., C.H.A. 2, Honolulu, Hawaii.
Perrone, John (C), Shop 26, Pearl Harbor Navy Yard, Honolulu, Hawaii.
Roe, Frank P. (C), Blaisdell Hotel, Honolulu, T. H.

PEORIA

Plank, Gerald W. (C), Caterpillar Tractor Co., % Training, Bldg. H.H., Peoria, Ill.
Teng, Pi-Yi (F), University of Illinois, Urbana, Ill.

PHILADELPHIA

Brogan, Edward K., Jr. (C), 2362 Locust St., Wilmington, Del.
McTamney Daniel G. (C), 4641 Lancaster Ave., Philadelphia 31, Pa.
Pratt, James A. (B), 817 Parmley Ave., Yeadon, Pa.

PITTSBURGH

Silliman, Frank P. (B), Hillman Barge & Construction Co., Box 510, Brownsville, Pa.

PORTLAND, ORE.

Tingley, Wm. M. (B), 3257 N. E. 66th, Portland 13, Ore.
Woods, Harold B. (B), 2746 N. W. Wake St., Portland 10, Ore.

PUGET SOUND

Coffman, George M. (C), % Skagit Steel & Iron Wks., Sedro-Woolley, Wash.
Dickinson, John W. (C), The Linde Air Products Co., 2901 First Ave. S., Seattle, Wash.
Liefelt, John F. (B), 502 Eastlake Ave., Apt. 402, Seattle 9, Wash.
Robertson, Robert H., SF 1-C (C), c/o F.P.O., San Francisco, Calif.

QUAD CITIES

Kopzcyk, Frank J. (B), International Harvester Co., Farmall Wks., Rock Island, Ill.
Parks, Paul Gordon (B), 2111 Grand Ave., Des Moines, Iowa.

SAN FRANCISCO

Doggett, Cecil W. (B), 7821 Outlook Ave., Oakland, Calif.
Hersey, T. Schuyler (C), Hersey Inspection Bureau, 3405 Piedmont Ave., Oakland 11, Calif.
Myra, Harold R. (B), 339 N. Ridge Rd., Bldg. 11, Sec. B, San Francisco 24, Calif.
Pinckney, George H. (C), Air Reduction Sales Co., 1813 Mills Tower, 220 Bush St., San Francisco 4, Calif.
Wells, Don (B), Iola Equipment Co., 1009 Cypress St., Oakland, Calif.
Zuckerman, David (B), Bethlehem Alameda Shipbldg., Inc., Alameda, Calif.

ST. LOUIS

Loveridge, Joel F. (B), 1008 Grandview Dr., Kirkwood 22, Mo.
Von Brecht, Forrest G. (C), White-Rodgers Electric Co., 1209 Cass Ave., St. Louis 6, Mo.
Wilcoxson, R. B. (C), 7544 Ethel Ave., Richmond Hts. 17, Mo.

SOUTH TEXAS

McKissick, J. A. (C), Big Three Welding & Equip. Co., 5611 Clinton Dr., Houston, Tex.

SYRACUSE

Reynolds, Fred W. (C), 703 Seneca St., Fulton, N. Y.
View, John J. (C), 410 Boyden St., Syracuse, N. Y.

TACOMA

Baker, Clayton (C), 5419 So. Oaks, Tacoma, Wash.
Bartolat, Edward P. (C), 5315 N. 35 St., Tacoma 7, Wash.
Bolton, Charles William (C), Box 67, Buckley, Wash.
Boutiette, Walter (C), 2120 N. Mason Ave., Tacoma 7, Wash.
Boyd, Jay Wm. (C), Rt. 13, Box 180-B, Tacoma, Wash.
Buchholz, R. N. (C), R-6, Box 209X, Tacoma, Wash.
Coien, Peter (C), Rt. 5, Box 464, Kent, Wash.
Culver, Ernest Orville (C), 2327 Mtn. View Blvd., Tacoma 6, Wash.
Hagedorn, Wayne Edwin (C), 231 S. 79th, Tacoma, Wash.
Henrion, Ray (C), 1915 Tacoma Ave. So., Tacoma, Wash.
Johnston, Richard L. (C) 3575 E. K St., Tacoma, Wash.
Jones, Sylvester (C), 1918 N. Mullen St., Tacoma 7, Wash.

Kellogg, Harold P. (C), 34 Idaho St., Lincoln Hts., Tacoma, Wash.
Ludington, Merrill E. (C), Route 1, Box 461A, Spanaway, Wash.
Mantell, Edward L. (C), 309 S. Jay, Tacoma, Wash.
Marine, Joseph S. (B), 2852 Division, Enumclaw, Wash.
Montgomery, F. O. (C), 813 S. 11th, Tacoma, Wash.
O'Brien, James E. (B), Route 8, Box 376, Tacoma, Wash.
Slimkorky, John (C), 1451 E. 28, Tacoma, Wash.
Spencer, John A. (C), 714 N. W. 3rd St., Puyallup, Wash.
Tileston, C. Frank, Jr. (C), 2346 S. Sprague, Tacoma 3, Wash.

TOLEDO

Baker, Robert C. (C), 2239 Georgetown Ave., Toledo 12, Ohio.
Newman, E. V. (B), 4021 Bowen Rd., Toledo, Ohio.

TULSA

Kiker, E. K. (B), Oklahoma Oxygen Co., 2750 Sand Springs Rd., Box 910, Tulsa, Okla.
Looney, R. L. (B), Lincoln Electric Co., Box 870, Tulsa, Okla.
Vonde Veld, L. D. (B), Vonde Veld Core Drilling Contrs., P. O. Box 980, Tulsa 1 Okla.

WESTERN MASS.

Morrissette, Theodore E. (C), 211 Center St., Indian Orchard, Mass.

WESTERN MICHIGAN

Bayle, Ellsworth (C), Pere Marquette Railway, Wyoming Shops, Grand Rapids, Mich.
Laylin, Erwin J. (B), Laylin's Welding Shop, R. R. 2, Box 248, Dowagiac, Mich.

YORK-CENTRAL PENNA.

Ressler, Robert L. (C), New Holland Machine Co., New Holland, Pa.

NOT IN SECTIONS

D'Cunha, James (C), B.I.T. 3-96, Love Lane, Mazagon, Bombay 10, India.
Hodgson, William R. (B), 204 Bristol Rd., G.V., Oak Ridge, Tenn.
Jackman, J. W. (B), Route 1, Box 276, Pensacola, Fla.
Languepin, Jaques E. (C), 20 Rue Toulouse Lautrec, Paris, France.
Thurmond, J. R. (C), 736—13th Ave. S., St. Petersburg, Fla.

Employment Service Bulletin

POSITIONS VACANT

V-165. Welding Engineer: To supervise inspection raw materials to finished product in plant manufacturing welding materials. Prefer technical background. Postwar position. Metropolitan New York area.

V-166. Wanted: Young research assistant. Candidate will have to work with research planning committees, attend meetings, assist committees. Knowledge of welding, metallurgy and physics desirable. Salary dependent upon age and experience. Permanent position.

SERVICES AVAILABLE

A-500. Manufacturing Engineer with fifteen years of practical business experience, and who has specialized in Welding for the last ten years, and has followed Resistance Welding methods, design and development for the past two years, is interested in Welding Sales, Welding Service, or a position of a supervisory capacity. Will travel or transfer to any location.

Members Reclassified

During month of May

BOSTON

Baillargeon, David V. (from D to C), 41 N. Main St., Newmarket, N. H.
Canning, Thomas K., Jr. (from D to C), 327 Lamartine St., Jamaica Plain 30, Mass.
Johnson, Harry R. (from D to C), 17 School St., Methuen, Mass.
McGuire, Frank J. (from D to C), 117 Greenfield Rd., Mattapan 26, Mass.

LEHIGH VALLEY

Gingrich, H. E. (from D to C), 405 Washington Ave., Bethlehem, Pa.

LOS ANGELES

Totten, Howard C. (from D to C), 820 Crenshaw Blvd., Torrance, Calif.

PHILADELPHIA

Blachstein, Maxwell (from D to C), 426 Pfeiffer St., Camden, N. J.
Gross, Charles A. (from D to C), 2544 N. Chadwick St., Philadelphia 32, Pa.
States, George (from D to C), 2008 E. Sergeant St., Philadelphia 25, Pa.

PITTSBURGH

Davison, Neville C., Jr. (from D to C), 238 Walnut St., Sewickley, Pa.
Frey, Nathan K. (from D to C), R. D. 1, New Wilmington, Pa.

PUGET SOUND

Liggett, Donald (from D to C), 1013 Benham St., Richland, Wash.

SAN FRANCISCO

Garrison, C. L. (from D to C), 305 Bridgeview Dr., San Francisco 24, Calif.

SOUTH TEXAS

Pavlu, Albert (from D to C), Hallettsville, Tex.

NOT IN SECTION

Nies, Edward A. (from D to C), Route 5, Gunnison Rd., Erie, Pa.

SAFETY GLOVE

A new safety glove made from high-grade chrome-tanned cowhide is announced by the American Optical Co., Southbridge, Mass. Ideal for welding, the new glove can also be worn for hand protection in other heavy-duty operations.

Principal feature of the new glove is its one-piece back construction. Because of this construction there are no seams on the back of the glove to catch sparks or molten metal.

The Gunn style of manufacture reduces the number of seams to an absolute minimum. To give added strength and protection, all vulnerable seams are welted.

The new glove, according to the concern, is carefully designed and expertly made to give long hard wear on the toughest jobs.